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Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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**Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor
Geneva T. Thompson, Asst. Editor**

Editor's note: This issue does not contain
a cumulative index for Volume 5 since
a five-year index is being prepared for
publication.

3591. Alverson, Dayton L. 1960. A STUDY OF ANNUAL AND SEASONAL BATHYMETRIC CATCH PATTERNS FOR COMMERCIALLY IMPORTANT GROUND FISHES OF THE PACIFIC NORTHWEST COAST OF NORTH AMERICA. Pacific Marine Fisheries Commission Bulletin 4, 66 pgs.

To study bathymetric catch patterns the range of depths fished by the fleet was divided into 10-fathom intervals, and the reported catches were assigned to particular depth zones according to time and area of capture. These data were then tabulated into four seasonal periods: January through March (winter), April through June (spring), July through September (summer), and October through December (fall). Monthly depths of capture were studied to provide information on timing and amplitude of vertical movements. Annual and seasonal depth-distribution patterns of fishing effort are presented along with bathymetric catch patterns for the 9 species taken by the Washington fishery.

Bathymetric migrations are indicated for English sole, petrale sole, Dover sole, starry flounder, true cod, Pacific ocean perch, and sablefish. Lingcod appear to migrate from areas normally fished by trawlers during summer months, and it is presumed that there is an emigration of mature fish to spawning areas not accessible to the fishing fleet. The apparent seasonal vertical migrations result in seemingly paradoxical seasonal changes in the productivity of the species complex. Highest individual catches for many species are made during the winter months, but highest aggregate catches for the species complex are taken during the summer. Knowledge of these bathymetric movements will play an important role in the management and understanding of the dynamic movements of the demersal fishes exploited in the northeastern Pacific Ocean. (Auth. summ.)

3592. Taft, Bruce A. 1960. A STATISTICAL STUDY OF THE ESTIMATION OF ABUNDANCE OF SARDINE (*SARDINOPS CAERULEA*) EGGS. Limnology and Oceanography, Vol. 5, No. 3, pp. 245-264.

The reliability of the estimation of abundance of sardine (*Sardinops caerulea*) eggs is examined from two points of view. Analysis of egg observations collected on spawning surveys off southern California in 1941 indicates that the counts are consistent with the hypothesis that the egg population is distributed according to the negative binomial contagious distribution. Calculation of 95% confidence limits shows that the cruise estimates are subject to a variation of one-half or double the estimate on the average. A seasonal estimate is probably subject to wider variation than the cruise estimates. Sardine egg observations collected from a 400 square mile grid of 25 stations off Baja California in 1952 over five days show important time and spatial variations. The coefficient of variation of an estimate of abundance of the egg population within the grid for the five day period

from a single observation is estimated to be 31.1. The corresponding coefficient of variation of a sum of 40 counts from the grid is 4.9. The implications of this variability for the design of egg sampling surveys are discussed. (Auth. abst.)

3593. Smith, Lloyd L., Jr., and Richard L. Pycha. 1960. FIRST-YEAR GROWTH OF THE WALLEYE, *STIZOSTEDION VITREUM VITREUM* (MITCHILL), AND ASSOCIATED FACTORS IN THE RED LAKES, MINNESOTA. Limnology and Oceanography, Vol. 5, No. 3, pp. 281-290.

First-year growth of the walleye, *Stizostedion vitreum vitreum* (Mitchill), was studied from 4,544 fish collected during the first summer of life in the Red Lakes in six seasons and from back calculations on 4,474 fish one year or more in age representing 17 year classes. Sexes did not differ in growth rate. Growth within the season varied greatly in different years and total growth deviated as much as 15.3% from the mean of the entire period. Water temperature, size of brood, and abundance of large walleyes and perch did not affect growth rate. Very early or late spawning influenced total growth during the season and final size and goodness or poorness of a season's growth was determined by the middle of July. Growth rate of young-of-the-year perch and total use of perch as food did not significantly influence growth. Incidence of perch in walleye stomachs ranged from 10.9 to 98.0% and spottail shiner was a more important food item in most years than perch. Total first-year growth of the walleye was apparently determined before fish became a major item in the diet. (Auth. abst.)

3594. Williams, Louis G. 1960. UPTAKE OF CESIUM BY CELLS AND DETRITUS OF *EUGLENA* AND *CHLORELLA*. Limnology and Oceanography, Vol. 5, No. 3, pp. 301-311.

Standard "*Euglena*" medium putrefied by three common species of bacteria and filtered was found to support unusually heavy blooms of *Euglena* and *Chlorella*. Mass culturing demonstrated that uptake of Cs^{137} by *Euglena* and *Chlorella* is linear with concentrations at all levels that might be encountered in natural aquatic habitats. The rate of uptake of cesium during population growth is greatest in cells of *Euglena* during the stationary period following the exponential growth phase. At this stage the cesium taken in is mostly unbound. Following this it is released so that in old cells and detritus it is largely bound cesium. Cesium and potassium behave independently in killed cells of *Chlorella*. Alkali ions, known to be chemically similar, are selected or rejected discriminately by these algae. The presence of antibiotics significantly depresses the uptake of cesium by *Chlorella* and *Euglena*. (Auth. abst.)

3595. Jones, Raymond F. 1960. THE ACCUMULATION OF NITROSYL RUTHENIUM BY FINE PARTICLES AND MARINE ORGANISMS. Limnology and Oceanography, Vol. 5, No. 3, pp. 312-325.

The accumulation of nitrosyl ruthenium¹⁰⁶ by fine particles, algae and animals from sea water is

described. The presence of ferric hydroxide on the sand and silt particles enhances Ru¹⁰⁶ accumulation. Uptake of Ru¹⁰⁶ by marine algae is a surface phenomenon associated with the extra-cellular polysaccharide material. Fish accumulate the nuclide principally in the gut, gills, and skin. In the case of mussels, the shell accounts for the major fraction of accumulated radioactivity. Nitrosyl Ru¹⁰⁶ species present in the radioactive effluent normally discharged to sea from Windscale Works are compared to nitrosyl Ru¹⁰⁶ of non-factory origin by paper chromatography. The addition of nitrosyl ruthenium trinitrate to sea water results in the formation of nitrosyl ruthenium chloride which is adsorbed to a greater extent than the Ru species present in the factory effluents. (Auth. abst.)

3596. Hoese, H. Dickson. 1960. BIOTIC CHANGES IN A BAY ASSOCIATED WITH THE END OF A DROUGHT. *Limnology and Oceanography*, Vol. 5, No. 3, pp. 326-336.

Heavy rainfall in early 1957 broke the most severe drought in the history of Texas. Resultant heavy river discharge reduced salinities in Mesquite Bay on the Central Texas Coast by over 30 ‰ in two months. Effects on the bay fauna were catastrophic with complete mortality of stenohaline marine sessile and infaunal mollusks. The flora and fauna of the high salinity drought period and of the subsequent low salinity period are compared. A high salinity *Ostrea equestris*-*Brachidontes exustus* community was replaced in 1957 by a *Crassostrea virginica*-*Brachidontes recurvus* community. The rapid lowering of salinity apparently did not kill fishes and other motile forms; in most cases these must have escaped by moving out of the area, but several stenohaline species were found in very low salinities immediately after the influx of fresh water. Mortality of euryhaline mollusks occurred in 1958 when salinities fell below 3 ‰. Some relations of organisms to salinity are discussed from ecological and paleoecological viewpoints. (Auth. abst.)

3597. Griffiths, Raymond C. 1960. A STUDY OF MEASURES OF POPULATION DENSITY AND OF CONCENTRATION OF FISHING EFFORT IN THE FISHERY FOR YELLOWFIN TUNA, *NEOTHUNNUS MACROPTERUS*, IN THE EASTERN TROPICAL PACIFIC OCEAN FROM 1951 TO 1956. *Inter-American Tropical Tuna Commission, Bulletin*, Vol. IV, No. 3, pp. 41-98.

This study shows how the catch and effort statistics, from 1951 to 1956, of the fishery for yellowfin tuna, *Neothunnus macropterus*, in the Eastern Tropical Pacific Ocean, have been used to compute: (i) two indices of average population density; (ii) an index of concentration of effort on areas of greatest density of available yellowfin. These three indices were then used to determine: (i) quarterly and annual variation in each of them; (ii) the relationship between the two indices of density; (iii) the relationship of each of the indices to the number of exploited one-degree rectangles.

To remove extreme sampling variation at low levels of effort, the data from all one-degree rectangles subjected to less than five logged days' fishing in a quarter were eliminated, and the computations were repeated for comparison with those of the original data. (Auth. summ.)

3598. Klawe, W. L. 1960. LARVAL TUNAS FROM THE FLORIDA CURRENT. *Bulletin of Marine Science of the Gulf and Caribbean*, Vol. 10, No. 2, pp. 227-233.

The collection of larval fish made in the Florida Current from May 1951 to October 1956 by the personnel of The Marine Laboratory contained 146 tunas. The following were represented: (1) tuna, *Thunnus* sp. or spp., most likely young of the bluefin tuna, *T. thynnus*; (2) oceanic skipjack, *Katsuwonus pelamis*; (3) little tunny, *Euthynnus alletteratus*; (4) frigate mackerel, *Auxis thazard*; and (5) 13 unidentified scombroid larvae. Capture of these larval fishes indicates that several tunas spawn in the Florida Current between March and October. (Auth. abst.)

3599. Aldrich, David V., and William B. Wilson. 1960. THE EFFECT OF SALINITY ON GROWTH OF *GYMNODINIUM BREVE* DAVIS. *The Biological Bulletin*, Vol. 119, No. 1, pp. 57-63.

Bacteria-free *Gymnodinium breve* were exposed to media with salinity values ranging from 6.3 to 46.0 ‰; the best growth occurred between 27 and 37 ‰. These results indicate *G. breve* to be a relative stenohaline dinoflagellate.

Field evidence associates high incidence of dense populations with salinity levels a few parts per thousand and below those of the offshore waters of the Gulf of Mexico. Our results suggest that this field distribution does not represent a salinity requirement per se, since salt concentrations equivalent to those of the open Gulf did not inhibit growth of this organism in culture.

No instances of optimal growth occurred in culture media with salinity levels of 24 ‰ or less. Under equivalent estuarine conditions salinity may be a limiting factor in the natural distribution of *G. breve*. (Auth. summ.)

3600. Doi, Takeyuki. 1960. ON THE PREDATORY RELATIONSHIPS AMONG BLUEFIN TUNA AND COASTAL FISHES IN THE SOUTHERN WATERS OF JAPAN. *Bulletin of the Japanese Society of Scientific Fisheries*, Vol. 26, No. 2, pp. 99-102.

As to theoretical models of prey-predator relationships among fishes, Volterra's differential equations are well-known. Nevertheless, there are a great deal of criticism that those equations cannot stand for real circumstances of community of fishes or animals. But as the equations are convenient to examine the community problems of fishes, discussions about the equations are now often presented.

This report is a trial to prove whether Volterra's equations are applicable to the predatory relationships between bluefin tuna, a predator, and coastal fishes in the southern waters of Japan. An electronic analogue computer was employed in solving the equa-

tion which is a kind of non-linear differential equation.

The following are the results obtained. First, relationships between bluefin tuna and common squid in the waters for the years 1951 to 1955 have been examined. In Fig. 2 the broken line, generated by a function fitter of the analogue computer, represents the actual variations in the stock of common squid for the years 1951 to 1956, and the other curves stand for the theoretical variations in the bluefin tuna computed by the analogue computer for various values of a parameter of Volterra's equation. The graphical form in the middle of theoretical curves is similar to an actual variation of bluefin tuna. Therefore, as far as those years are concerned, it seems that these two fishes are in prey-predator relationships fitted to Volterra's equation.

In the second place, for the years 1951 to 1956 instead of to 1955, it was found impossible to make a theoretical graphical form similar to actual variations of bluefin tuna. But when total catch of coastal fishes is considered instead of common squid alone, it is possible to find out the predatory relationships between bluefin tuna and the sum of coastal fishes for the years 1951 to 1956, as shown in Fig. 4.

From these results it is concluded that bluefin tuna and coastal fishes including common squid are in predatory relationships in the southern waters of Japan. (Auth. abst.)

3601. Ishio, Shinya. 1960. THE REACTIONS OF FISHES TO TOXIC SUBSTANCES--I. NEW DESIGNED GRADIENT TANK FOR STUDYING AVOIDANCE REACTIONS OF FISHES. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 349-353.

A number of investigators have devised avoidance tanks of different types for studying the reactions of fishes to toxic substances, atmospheric gases or temperature (1)~(7). Those tanks were, however, not so convenient for the performance of studies as mentioned above, because of the instability of toxic gradient formed, and the difficulty of operation for the tank to work properly. Especially, it made the accomplishment of the studies difficult to have to repeat the tests, making use of various concentrations of a toxicant and also exchanging used fishes for unused fishes in each test.

The present author has made a new designed gradient tank in which the concentration of toxicant introduced at one end decreased gradually with the distance that the stream moved down toward the outlet at opposite end. When fishes were put into the tank, they detected the unfavorable concentrations of toxic gradients and escaped away to the safe concentrations. The estimation of the concentrations of toxic substances which fishes avoid or prefer has become, therefore, much easier than before.

This paper, thus, deals with the structure of the new tank and the gradients formed in it. (Auth. abst.)

3602. Kashiwada, Ken-ichi, Daiichi Kakimoto, and Akio Kanazawa. 1960. STUDIES ON VITAMIN B₁₂ IN NATURAL WATER--VI. CHANGES OF

VITAMIN B₁₂ CONTENT IN THE WATER. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 321-325.

The vitamin B₁₂ content in natural water varies with the conditions of sampling, such as the season of year, the time of day, the depth of water, etc. Since said variation has distorted the data thus far published about vitamin B₁₂ content in natural water, a few confirmatory studies were made.

When samples of natural water were placed in vases and kept in a dark place, B₁₂'s in these samples increased, attaining their maximum contents in two or three days and decreasing afterwards. This is a general tendency and may perhaps be attributed to the work of bacteria originally contained in the sample waters.

Samples taken from upper layers (0~50m in depth) of the water of Lake Ikeda, when kept in the conditions the same as those under which the above samples were stored, uniformly showed noticeable changes of vitamin B₁₂ contents in the first seven days, while samples taken from deeper layers showed increases of B₁₂ only in the first day and decreased after that time to stationary values which were not always strictly constant. In a nutshell, at the surface layer (0~20M) a considerable loss of B₁₂ was to be seen, while at the depth of 30m or more hardly any was. Thus it seems necessary for any researcher who attempts to examine B₁₂ content or to make water-sampling of it to take the loss of B₁₂ by sunlight effects into consideration. (From auth. abst.)

3603. Uchihashi, Kiyoshi. 1960. ON THE SWIMMING LOCALIZATIONS OF FISH. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 273-276.

Goldfishes and carps were arranged in three groups, namely of normal ones, of blind ones, and of blind ones of which lateral lines had been removed and the receptors of facial nerves had been incinerated. As for goldfishes and the carps the blindness seemed to have caused some difficulties in localizing them against stream. When blind goldfishes or carps shifted to the region where the direction and the velocity were somewhat different from the main stream, it seemed easier for them to localize themselves against it. When the lateral lines of blind carps had been removed, a great difficulty was observed for them in localizing themselves against stream. But when their bodies contacted some fixed objects, the counter-stream localization was observed. Blind carps whose lateral lines had been removed, and whose tactile organs in their faces had been incinerated could never localize themselves against stream. No significant difference was observed between the ability of counter-stream localization of a goldfish and that of a carp. (Auth. abst.)

3604. Hashimoto, Tomiju, Minoru Nishimura, and Yoshinobu Maniwa. 1960. DETECTION OF FISH BY SONOBUOY. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 245-249.

The detection of fish shoal by their swimming sound is usually made by research vessels, or, in

case of set net fishing, by the cable transmission of under-water sound to coastal receiving stations.

To listen simultaneously to the sea noises of several locations or survey the fish location by the sound originated from fish school, it has been demonstrated that the sonobuoy's disposition offers an easier and more economic survey. The observation is made by setting several sonobuoys at sea and receiving the under-water sound through the radio system at a coastal station.

The sonobuoy device consists of hydrophone, audio amplifier, radio transmitter and receiver, speaker, pen-recorder and tape recorder. The under-water signal received by hydrophone is recorded on the penrecorder or on the magnetic tape recorder. The effective communication range of sonobuoy is up to 10 km.

The observation obtained at fixed set-net fishing ground has demonstrated that the sonobuoy can clearly distinguish the sound of fish school (mainly yellow-tail) from the sea noise, and that the frequency of sound generation at the entrance of net-set has a certain relation with probable catch of yellow-tail.

We can conclude that in future, the forecast of fish catch may be possible by listening to the sound of fish by means of such a device. (Auth. abst.)

3605. Kittaka, Jiro. 1960. ON THE SIGNIFICANCE OF THE CHANGE OF POND WATER IN CULTIVATION OF MARINE FISH. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 230-238.

Recently, cultivation of Hamachi (the young of *Seriola quinqueradiata*) has been carried on in various districts along the coasts of the Seto Inland Sea. The culture ponds now in use may be divided broadly into two types. The pond of the first type ("channel" type) is constructed by erecting stone dams at both ends of a narrow channel between two islands. Ponds of Agheshima and Kiheijima fish farms are of this type. The pond of the other type ("bay" type) is made by stretching wire-netting or fishing net at the mouth of a small bay. Representatives of the ponds of this type are found at Kukura and Uto fish farms. Sea water flows into or from the ponds, more or less freely, by tide and tidal current, passing through sluices of the dam in the former or through net meshes in the latter.

In the present study, investigation was made on some physical and chemical characters and change or circulation of the sea water of several Hamachi-ponds of these types, with special reference to the possible relation between change of pond water and carrying capacity of the pond.

In the ponds of the channel type, sea water continually flowed into them through sluices of either of the opposite dams, except about an hour or two at low water. In the ponds of the bay type, on the contrary, the inflow of sea water discontinued from high water to low one. Consequently, the vertical gradient of the environmental factors was less remarkable in the latter than in the former.

It was established both theoretically and observationally that the oxygen concentration of the pond water was determined by three principal agents, viz., change or circulation of pond water, absorption of atmospheric oxygen and respiration of fish. It was, likewise, demonstrated that the ammonia concentration was varied mainly due to change of the pond water and excretion of fish.

A positive, linear relation was found to exist between the degree of change of the pond water and the carrying capacity of the fish pond. (Auth. abst.)

3606. Kojima, Shumppei. 1960. FISHING FOR DOLPHINS IN THE WESTERN PART OF THE JAPAN SEA—VI. BEHAVIOURS OF FISH GATHERING AROUND BAMBOO RAFTS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 4, pp. 383-388.

Behaviours of the dolphin (*Coryphaena hippurus* L.) and other fishes taking shelter around bamboo rafts were observed at sea off Hamada, Shimane Prefecture during the 1955-58 seasons. All the fish attracted to the shelter were found staying in parallel with it. Most of them were centering either around the anchor line or at the head of the raft held against the current, but very few were at the tail of the raft.

In an underwater observation carried out in the daytime, the shadow of the raft was not so visible as it was from above the surface. Therefore, the area of the shadow assumed from the position of the sun and the raft was compared with the distribution of fish around the shelter. The result revealed that a particular part of the shelter attracting fish was more dependent on the direction of the current than on the position of the shadow.

Among the various species swarming about the raft, the smallest was "mejina" (*Girella punctata* Gray) of about 5 cm. in length. When the author held out the hands to scare them, they fled away a little from the shelter but soon returned there again, without being driven off by the current. From that finding it may be feasible to consider that fish staying at the shelter are those having grown enough to resist against a normal speed of the current. When the current was unusually fast, however, a very few dolphins, and still less the others, could apparently stay with the raft.

At night a lamplight held alongside the shelter was successful in getting dolphins to come out of the shelter. Seemingly the fish would stay under the shelter overnight.

In vertical distribution along the anchor line, the larger the size of fish, the further they stayed away from the raft. Tendency in the horizontal distribution appeared nearly similar but was not so clear as in the vertical pattern. (Auth. abst.)

3607. Mito, Satoshi. 1960. EGG DEVELOPMENT AND HATCHED LARVAE OF THE COMMON DOLPHIN—FISH, *CORYPHAENA HIPPURUS* LINNE. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 3, pp. 223-226.

The ovarian egg of this fish is buoyant, spherical in shape, measuring 1.2-1.6 mm in diameter, with

a single light yellow oil globule measuring 0.3~0.4 mm in diameter.

The yolk is coarsely segmented, but after being preserved, these segmentations became indistinct.

According to the occurrence of eggs and larvae in the sea, and the examination of the gonad of this fish, the spawning season around Kyushu seems to extend from late May to late August. The hatching took place in about two days at the water temperature 24~26°C. During the course of egg development, many melanophores and xanthophores appeared on the embryonal body, yolk and oil globule.

The larva was 3.95 mm in total length, with the oil globule situated at the posterior part of the yolk, and the anus opened somewhat posteriorly to the middle of the body. The myotome number was 17 + 15 = 32 (the vertebral number of this fish being 31).

Melanophores and xanthophores were scattered nearly all over the body, yolk and oil globule, but on the marginal fin there were observed only the xanthophores.

Soon after hatching, the chromatophores became larger and approached to each other, and the xanthophores on the marginal fin shifted to its margin.

In 4 days after hatching, the yolk and oil globule were entirely consumed and the larva attained 5.70 mm. The xanthophores of the marginal fin became faint. The myotome number and the position of the anus remained unchanged.

3608. Kojima, Shumpei. 1960. FISHING FOR DOLPHINS IN THE WESTERN PART OF THE JAPAN SEA—V. SPECIES OF FISHES ATTRACTED TO BAMBOO RAFTS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 4, pp. 379-382.

During the months from June to October "Shiira-zuke" fishery is operated off Shimane Prefecture on the Japan Sea coast with help of bamboo rafts serving as floating shelters for the dolphin, *Coryphaena hippurus*, and other fishes. In catching fish gathering around the shelters purse seines are used. The present work deals with relative importance of catches by species and individual size on the basis of the data made available for the 1955~58 seasons.

In Table 1 the amount of landings from four fishing units is indicated by species and month. As the fishing season lasts from early summer till autumn, a majority of catch is represented by warm-water species. Of the total weight of the annual catch, the dolphin occupied 93~96 percent, the rest being composed of such species as *Seriola*, filefish (*Monacanthus cirrhifer*), and hardtail (*Caranx helvolus*). Each of them seems to occur in almost the same months every year under study. As skipjack and tunas can not be caught by purse seine, their catches as in Table 1 must have been made by angling during the trip from one shelter to another.

Numbers of individuals sampled from "shiira-zuke" catches at various ports were identified as to species, and the total length of them measured. In a report by previous workers the size of fish fol-

lowing drifting seaweed was noted. They were smaller in size than those observed in the present work. Differences in the size of fish are attributable to the fact that the former group of fish following drifting substance is too small, while the latter staying with the bamboo shelter kept at a point is large enough to resist the current. (Auth. abst.)

3609. Kadota, Sadami. 1960. STUDIES ON THE LIMNOLOGY OF THE LAKES OF YATSUGATAKE LAKE GROUP— I. OBSERVATIONS ON THE FEEDING HABITS OF THE PLANKTON OF LAKE SHIRAKOMA. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 5, pp. 452-461.

The contents of the alimentary canal of *Diaptomus* and *Daphnia* collected from Lake Shirakoma were microscopically observed. The inquiry was of interest because the lake was quite destitute of phytoplankton, and therefore what might be the food stuff of these species was curious and important.

The food of *Diaptomus* and *Daphnia* of this lake consists exclusively of bottom materials which, as a matter of course, contain bottom organisms such as lower *Cyanophyceae*, *Diatoms*, etc. Remarkable was the fact that little or no plankton organisms were found in the alimentary canal of these species.

The food of *Diaptomus* and *Daphnia* was all the same in its constituents. The quantity, however, seemed to be a little more in *Daphnia* than in *Diaptomus*.

As to the size of food particle it was found that the size taken by *Daphnia* is markedly larger (maximum length-311 μ) than that taken by *Diaptomus* (maximum length-238 μ). However, the mean size of food particle was 50 μ or thereabout, a size exceeding 100 μ (in length) was very rare.

The finding that *Diaptomus* and *Daphnia* largely feed on bottom materials, at least in Lake Shirakoma, suggests the possibility of bottom materials being the cause of the vertical migration of these two species. (Auth. summ.)

3610. Kobayashi, Tetsuo. 1960. AN ECOLOGICAL STUDY ON THE SALMON FRY, *ONCORHYNCHUS KETA* (WALBAUM)— VI. NOTE ON THE FEEDING ACTIVITY OF CHUM SALMON FRY. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 6, pp. 577-580.

An experimental observation has been done to understand the relationship between feeding activity and the general behaviour in chum salmon fry during seaward migration.

The result indicated that feeding activity of the fish is more active at night than in the daytime, beginning feeding activity vigorously when light intensity reduces to about 0 lux after sunset. This feeding activity of the fish seems to be restricted by light, as the movement of the fry during seaward migration is caused by darkness. However, the natural habit in the movement of the fish can be changed artificially by the continued supply of food in the daytime.

It is highly probable that the feeding activity of chum salmon fry has nothing to do with the gradual change of water temperature.

It was ascertained that the growth rate of the fry which were fed during the night (B Group) is greater than that of the fry fed in the daytime (A Group). (Auth. abst.)

3611. Parry, Gwyneth, and F. G. T. Holliday. 1960. AN EXPERIMENTAL ANALYSIS OF THE FUNCTION OF THE PSEUDOBANCH IN TELEOSTS. The Journal of Experimental Biology, Vol. 37, No. 2, pp. 344-354.

The effects of removal of the pseudobranch have been studied in four species of marine fish and two species of fresh-water fish. No evidence was found for any direct effect upon osmoregulation or respiratory exchange. Removal of the pseudobranchs was followed by the darkening of the fish, due to chromatophore expansion, and after some weeks, by the degeneration of the choroid gland in the eye.

It is suggested that the pseudobranch produces, or activates, a hormone affecting the chromatophores and that the entry of this hormone into the general circulation is controlled by the choroid gland. (Auth. summ.)

3612. Clunies-Ross, C. W., and R. H. Riffenburgh. 1960. GEOMETRY AND LINEAR DISCRIMINATION. Biometrika, Vol. 47, Nos. 1 and 2, pp. 185-189.

The problem to be considered is that of identifying, or of classifying, an observed individual as being a member of one of two "populations", in particular when the restriction to equal variance-covariance matrices is relaxed but the restriction to linearity of the discriminator is retained. The populations are to be considered as giving rise to observable individuals each of which may be (partially) characterized by a set of k measurements. The measurements of individuals from either population are distributed as if they were independent observations on a multivariate distribution of probability. These distributions are assumed to be multivariate normal, with known parameters, for each population.

Let P_I denote the probability that a random individual of population I is classified as having arisen from II, and P_{II} denote the probability that a random individual of II is classified as having arisen from I. Then two criteria for joint minimization of the probabilities of error are introduced, viz. $P_s = P_I + P_{II}$ and $P_x = \max(P_I, P_{II})$. If we let A be a row vector of direction numbers, X be a row vector of variables, c be a constant, and let primes denote transposition, then a linear discriminator may be written: $AX' = c$. Let (m_1, σ_1^2) , (m_2, σ_2^2) be the mean and variance of AX' when X is distributed as in population I, II, respectively. We lost no generality if we let $m_2 > m_1$ and $\sigma_2 \geq \sigma_1$. The problem of this paper is the establishment of c under the various conditions. A consideration of the vector A is given in another paper by the authors.

The minimization of P_s yields a c given by

$$\frac{1}{\sigma_2^2 - \sigma_1^2} \left\{ \sigma_2^2 m_1 - \sigma_1^2 m_2 + \sigma_1 \sigma_2 [(m_2 - m_1)^2 \right.$$

$$\left. - 2(\sigma_2^2 - \sigma_1^2) \ln \frac{\sigma_2}{\sigma_1} \right\}^{1/2}$$

and the minimization of P_x yields a c given by

$$\frac{m_1 \sigma_2 + m_2 \sigma_1}{\sigma_2 + \sigma_1}$$

If $\sigma_1 = \sigma_2$, either c reduces to the well-known

$$\frac{m_1 + m_2}{2}$$

The effects of known loss functions and prior probabilities are considered. The conditions under which each c is best are considered at length. (Auth. abst.)

3613. Nace, R. L. 1960. WATER--WHAT IS HAPPENING TO IT? Virginia Wildlife, Vol. XXI, No. 9, Sept. 1960, pp. 4-7.

Some water uses, shortages, water quality control needs, long range responsibility of management, the mission of the Geological Survey and what is happening to our water are discussed. The water program needs of the country as a whole are: Careful appraisal of the total water supply including ground water available and the extent to which it can be managed for best use. Thorough analysis of the present water situation in terms of total water use; natural consumptive use; artificial consumptive use; waste or escape of water that might be recovered; effects of man's activity on runoff, water supply, ground water recharge, erosion, and sedimentation; and sources and quantities of natural, industrial, and sewage contaminants. Determination of where we are headed in water use and where we ought to be headed. Development of a program to get where we want to go; means to control and guide our water destiny. Finally, a plan of action to carry out the program. This should be more than a list of projects and construction schedules; it should include action to get and make the most of scientific information.

3614. Chapman, D. G., and D. S. Robson. 1960. THE ANALYSIS OF A CATCH CURVE. Biometrics, Vol. 16, No. 3, September 1960, pp. 354-368.

The age distribution of a random sample, or the "catch curve" from a stationary animal or fish population, provides information on the annual survival rate of the population. The usual assumptions imply that the age distribution in such a population is geometric. The best (minimum variance unbiased) estimate of the annual survival rate is $\bar{X} [1 + X - (1/n)]^{-1}$, X being the mean age and n the sample size. This estimate is compared to the so-called "Jackson" estimate and some modifications of Jackson's estimate. Assumptions basic to regression estimates of the survival rate are considered.

A test of the model is given for the particular case where it is suspected that there may be selection against younger ages. With the geometric age distribution there is no unbiased estimate of i , the instantaneous mortality rate, but a nearly unbiased estimate is given by $1* = \ln [1 + \bar{X} - (1/n)] - \ln \bar{X} - [(n-1)(n-2)/n(t+1)(n+t-1)]$ where $t = n\bar{X}$. (Auth. summ.)

3615. Swain, A., I. R. H. Allan, and M. J. Bulleid. 1960. RECAPTURE IN THE RIVER TWEED OF A SEA-TROUT MARKED IN DEVONSHIRE. *Nature*, Vol. 187, No. 4740, September 3, 1960, p. 877.

Recaptures of tagged sea-trout (*Salmo trutta* L.) indicate that migrations are more extensive than has hitherto been supposed. One traveled a minimum distance of about 580 miles and another 244 miles.

3616. Wolf, Ken, M. C. Quimby, and E. A. Pyle. 1960. TRYPTIC DISPERSION OF SALMONID FISH TISSUE FOR IN VITRO CULTIVATION. *Excerpta Medica*, Vol. 14, No. 5, Section 1, pp. 354-355.

Gonads from sub-adult or early ovigerous ovaries from adult rainbow trout (*Salmo gairdneri*) were minced, washed, and added to 20 vols. of Dulbecco and Vogt's phosphate buffered saline modified to pH 7.3 and containing 2.5% to 5% human serum and 0.25% trypsin. The digestion mixture was agitated on a magnetic stirrer at 4° to 10°C until at least 2×10^5 cells/ml were released (several hours). Satisfactory results were also obtained from overnight digestion (17 to 25 hours). Suspended cells and small pieces of tissue were decanted then sedimented at 800 rpm for 20 min. and washed twice in a serum-containing BSS or Melnick's monkey kidney medium. The harvest of cells was diluted in 400 vols. growth medium or at a counted density of 25,000 to 150,000 cells/ml. ignoring aggregates of nondispersed cells. Incubation was in static tubes at 19°C. A sheet of epithelial and fibroblast-like cells developed in about 6 days. Medium with initial pH of 7.2 to 7.4 consisted of 10% cord serum, 30% SH 199, 0.5% LAH, and 59.5% Earle's BSS. Melnick's monkey kidney medium with or without additional serum has been satisfactory. Tissue and cells of this cold-water animal were kept below 10°C and at a pH of 7.2 to 7.4 through processing, precautions necessary for optimal survival of released cells. The monolayer of ovarian cells has proven to be susceptible to the virus of infectious pancreatic necrosis of fish.

3617. Allen, K. Radway. 1960. EFFECT OF LAND DEVELOPMENT ON STREAM BOTTOM FAUNAS. *Proceedings of the N. Z. Ecological Society*, No. 7, pp. 20-31.

The most striking feature of land development in New Zealand has been the removal of the original forest cover from a large proportion of the land, and its replacement by pasture. Although no historical data are available, study of present conditions indicates that this change had comparatively little effect on the bottom fauna of streams.

The less conspicuous changes in land use in recent years which result from more intensive and efficient agriculture are, by contrast, having a pronounced effect upon the bottom fauna. The changes arise primarily from the increased supply of nutrients in the water; this increases the quantity of attached algae growing on the stream bed, and changes their nature; the changes in physical environment

and food supply so produced cause qualitative changes in the nature of the bottom fauna.

In the Wellington area a large number of streams have been found to be modified. In all cases the streams affected rise in relatively low hills in pasture or arable land. It is unlikely that large rivers rising in high or bush-covered country will be affected.

3618. Clark R., and E. Polish. 1960. SOUND PRODUCTION BY THE SATINFIN SHINER, *NOTROPIS ANALOSTANUS*, AND RELATED FISHES. *Science*, Vol. 132, No. 3421, July 1960, pp. 222-223.

Several sounds are produced by minnows. Only one is not of purely mechanical origin, and it is classed as a "biological" sound. This sound is variously produced by males when fighting and chasing as well as during courtship. Females emit a similar sound. Testosterone injections and elevated temperatures result in an increased rate of biological sound emission. (Auth. abst.)

3619. Otsu, Tamio. 1960. ALBACORE MIGRATION AND GROWTH IN THE NORTH PACIFIC OCEAN AS ESTIMATED FROM TAG RECOVERIES. *Pacific Science*, Vol. XIV, No. 3, pp. 257-266.

Of 1,201 albacore tagged in the temperate North Pacific Ocean by POFI between January, 1954, and August 1957, 15 recoveries (1.2 per cent) were reported. These recoveries indicate considerable movement of fish in the North Pacific. Albacore tagged in mid-ocean north of Hawaii have been retaken in the American West Coast fishery as well as in the Japanese fisheries. Certain recoveries were of fish which migrated across the Pacific from the American West Coast to the vicinity of Japan. There is indication that Americans and the Japanese are exploiting the same population of albacore in the temperate North Pacific Ocean.

The data on growth, although insufficient for a conclusive study, were subjected to a preliminary analysis by Walford's method of growth curve transformation, and the resulting data were also fitted in a Gompertz equation. The derived growth curves are presented.

At least those portions of the growth curves for which there are observed data appear to be a reliable representation of albacore growth. Those curves are curvilinear, contrary to several linear albacore growth curves reported in the past by workers who based their studies mainly on the vertebral method. The linearity of the latter curves suggests that the age of albacore cannot be determined by the vertebral method; the rings on the centra are probably directly associated with growth rather than with age.

The results indicate that the albacore is a relatively slow-growing tuna with a rather long life span. A significant portion of the life span is passed in the immature state.

Although POFI in cooperation with the Japanese has tagged 270 albacore in the Japanese live-bait fishery, and the Japanese have recently started a tagging program in the western Pacific, none of these fish has been recovered in the American fishery. In

view of the fact that the Japanese exploit generally larger albacore than the Americans, the chances for recovery in the American fishery of Japanese-tagged albacore are far less than for Japanese recovery of American-tagged fish. (From auth. summ.)

3620. Weaver, David L. 1960. OUR MOST UNIQUE LAKE. *Outdoor Indiana*, Vol. IV, No. 2, August, 1960, pp. 20-22.

This popular article on Willow Slough Lake, Indiana includes a table listing number of anglers, hours fished, and number of fish caught (by species) during May and June, 1955 through 1960.

3621. Stewart, F. H. C. 1960. PHASE RELATIONSHIPS AND SPREADING BEHAVIOUR OF CETYL ALCOHOL MIXTURES. *Australian Journal of Applied Science*, Vol. II, No. 1, pp. 157-168.

Following Vines and Meakins' (1959) observations that the spreading behaviour of commercial cetyl alcohol appeared to be associated with the occurrence of different polymorphic modifications, the phase transformation temperatures of a series of commercial products and artificially prepared mixtures have been determined. The spreading rates of pure cetyl alcohol and a number of mixtures have also been measured. The results of these measurements have been interpreted in the light of X-ray diffraction data to indicate that the spreading rate of a cetyl alcohol mixture depends on both the phase behaviour and the chemical composition, the temperature, and the presence of water. (Auth. summ.)

3622. Moav, Rom, G. Wohlfarth, and M. Lahman. 1960. GENETIC IMPROVEMENT OF CARP. II. MARKING FISH BY BRANDING. *Bamidgeh, Bulletin of Fish Culture in Israel*, Vol. 12, No. 2, pp. 49-53.

A method of marking carp by branding has been developed. Despite some distortion of the brand-marks and growth of new scales on the scars (on scaleless skin of mirror carp) satisfactory results were obtained in marking 30-50 gram fingerlings. The method has been used successfully in comparison experiments where morphologically indistinguishable fish had to be grown in the same pond.

By means of double marks with 10 symbols up to 100 fish were marked with individual numbers. (Auth. summ.)

3623. Jessen, Robert L., and Jerome H. Kuehn. 1960. A PRELIMINARY REPORT ON THE EFFECTS OF THE ELIMINATION OF CARP ON SUBMERGED VEGETATION. *Minnesota Department of Conservation, Minnesota Fish and Game Investigations, Fish Series Number 2*, pp. 1-12.

In August of 1957 an investigation was initiated to document the changes taking place in seven shallow southern Minnesota lakes following the natural eradication and exclusion of carp by a hard winter-kill in the winter of 1955-56 with subsequent low water levels which prevented their reintroduction.

All seven lakes had a history of high carp populations and a complete absence of submerged vegetation.

Subsequently six of the seven lakes were found to have an abundance of submerged vegetation, while the seventh had none.

The abundance of submerged vegetation and an associated utilization of these lakes by migrating waterfowl was attributed primarily to the absence of a high carp population. However, the absence of vegetation in lakes is not due to carp action alone, as evidenced in one lake.

It is anticipated that during coming years carp will again become plentiful in these lakes, at which time their effect on the vegetation will be studied further. (Auth. abst.)

3624. Scidmore, W. J., and Donald E. Woods. 1960. SOME OBSERVATIONS ON COMPETITION BETWEEN SEVERAL SPECIES OF FISH FOR SUMMER FOODS IN FOUR SOUTHERN MINNESOTA LAKES IN 1955, 1956, AND 1957. *Minnesota Department of Conservation, Minnesota Fish and Game Investigations, Fish Series No. 2*, pp. 13-24.

Information on the summer food habits of carp, sheepshead, bigmouth buffalo, black crappies, white crappies, bluegills, walleye, pumpkinseed, perch and white sucker was obtained by analyzing the stomach contents of fish taken by seining in four southern Minnesota lakes during the summers of 1955, 1956 and 1957. Food habits for most species were about the same from lake to lake (when the same species were taken from several lakes). Preference was indicated for certain food items even though other foods were present. Aquatic insects were preferred by bluegills and sheepshead, and cladocera and copepods by crappies and buffalo. Feeding habits of carp were omnivorous but about one-third of the diet of larger carp was plant material.

It appears that removal of "rough fish" per se to reduce competition for food is too broad and general a concept. Removal should be aimed at the kinds and sizes of rough fish that are the principal food competitors of the desired game fish. (Auth. abst.)

3625. Hale, John. 1960. SOME ASPECTS OF THE LIFE HISTORY OF THE SMELT *OSMERUS MORDAX* IN WESTERN LAKE SUPERIOR. *Minnesota Department of Conservation, Minnesota Fish and Game Investigations, Fish Series, Number 2*, pp. 25-41.

A four-year study of the smelt in Minnesota waters of Lake Superior has revealed information on: (1) dates and duration of spawning runs; (2) age, size, and sex composition of the spawning population; (3) location and nature of the spawning grounds; (4) period of egg incubation; and (5) feeding habits of smelt and lake trout taken from the same waters. The crustacean *Mysis relicta* is the most important food of smelt of all sizes. Fish are occasionally eaten by smelt, but most of those found in the stomachs were young-of-the-year smelt, and only three trout were found in 1,065 stomachs examined. (Auth. abst.)

3626. Scidmore, W. J. 1960. EVALUATION OF

PANFISH REMOVAL AS A MEANS OF IMPROVING GROWTH RATES AND AVERAGE SIZE OF STUNTED FISH. Minnesota Department of Conservation, Minnesota Fish and Game Investigations, Fish Series, Number 2, pp. 42-51.

Panfish removal designed to improve average size and rate of growth of sunfish and crappies in overcrowded panfish populations has been carried on in 37 Minnesota lakes.

An investigation of the effects of removal in five of these lakes where 1.3 to 21.3 pounds of sunfish per acre were removed by seine and trap-nets indicated that removal of these amounts was ineffective for increasing average size or rate of growth of bluegills. It is concluded the amounts removed were not sufficient to produce the desired effect. (Auth. abst.)

3627. Johnson, Merle W. 1960. THE EFFECTIVENESS OF TOXAPHENE AT LOW TEMPERATURES. Minnesota Department of Conservation, Minnesota Fish and Game Investigations, Fish Series, Number 2, pp. 52-54.

A study was made to determine effectiveness of toxaphene as a fish toxicant in water at low temperatures.

A complete kill of fathead minnows *Pimephales promelas* was achieved at temperatures of 33° to 39°F. in nine days at concentrations of 0.05 p.p.m. toxaphene and in 31 days at 0.02 p.p.m. toxaphene. This compares with complete kills in 56° water in six days at 0.05 p.p.m. toxaphene and eleven days at 0.02 p.p.m. toxaphene. (Auth. abst.)

3628. Arnold, Edgar L., Jr. Ray S. Wheeler, and Kenneth N. Baxter. 1960. OBSERVATIONS ON FISHES AND OTHER BIOTA OF EAST LAGOON, GALVESTON ISLAND. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 344, 30 pgs.

From November 1953 to May 1958, collections of biological material by plankton net, cast net, and dip net were made in the vicinity of the mouth of East Lagoon, Galveston Island, with emphasis being placed on the seasonal occurrence and abundance of fishes. Results of these collections, coupled with visual observations, are presented and discussed. Thirty-five families of fishes were found to occur, dominated by the Clupeidae, Engraulidae, Sparidae, Sciaenidae, and Mugilidae. Concurrent water temperatures and salinities are presented in tabular form. (Auth. abst.)

3629. Strickland, J. D. H. 1960. MEASURING THE PRODUCTION OF MARINE PHYTOPLANKTON. Fisheries Research Board of Canada Bulletin No. 122, 172 pgs.

The table of contents includes: Section I. Definitions and Conversion Factors - A. Definitions - 1. Plankton Terminology; 2. Productivity Terminology; 3. Plant Pigment Terminology. B. Conversion Factors - 1. Rate Factors; 2. Standing Crop Factors. Section II. Chemical Composition by Phytoplankton - A. Elementary Composition;

B. Major Molecular Constituents; C. Pigments. Section III. Measurement of Standing Crop - A. Sampling Problems; B. Estimation by Counting and the Measurement of Weight or Volume; C. Estimation from Carbon Content; D. Estimation from Nitrogen, Phosphorus and Specific Organic Constituents; E. Estimation by Pigment Analysis; F. Some Results of Standing Crop Determination. Section IV. Measurement of the Rate of Photosynthesis - A. Photosynthesis and Respiration; B. Sampling Problems; C. Direct Measurements; D. Estimation by Carbon Dioxide Consumption; E. Estimation by Oxygen Evolution; F. Estimation from the Rate of Carbon-14 Uptake; G. Methods Based on Pigment Content; H. Other Methods; I. Some Results of Rate Determination Measurements. Section V. Primary Productivity - A. Productivity Index; B. General Growth Kinetics; C. Productivity Measurement in Nature.

3630. Matsumoto, Walter M. 1960. THE APPLICATION OF PAPER CHROMATOGRAPHY IN IDENTIFYING TUNA LARVAE. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 337, 9 pgs.

In order to seek a quicker and easier means of identifying larvae of various species of tunas, experiments in paper partition chromatography were attempted. In this initial attempt the tests were limited only to determinations on the free amino acid content in the muscle tissue of these fishes. The results suggest that paper chromatographic technique has possible utility as a taxonomic tool for adult tunas. For the larvae, however, the results were rather inconsistent. It is believed that these inconsistent results were due to inadequate application of the technique rather than to failure of the technique itself. (Auth. abst.)

3631. Robinson, John B. 1960. THE AGE AND GROWTH OF STRIPED BASS (*ROCCUS SAXATILIS*) IN CALIFORNIA. California Fish and Game, Vol. 46, No. 3, pp. 279-290.

Striped bass collected in 1957 and 1958 were studied to determine whether significant changes in the growth rate had occurred during the last 30 years. The growth rate was determined by aging scales and back calculating the growth. The length-weight relationship was also determined.

It was found that the growth rate is similar to that found in California 30 years ago, and in most other striped bass populations. However, it does show that there has been a significant increase in the growth rate of California striped bass between the ages of III and VII during the last 30 years. This difference reaches a maximum of about 2.5 inches at ages VI and VII.

No significant changes were found in the length-weight relationship, but, because of the increased rate of growth, the mean weight of bass at a given age is greater.

The age and growth data from this study are more favorable for the size limit increases made in 1956 than the growth data available for evaluation at that

time. (Auth. summ.)

3632. Wendler, Henry O. 1960. THE IMPORTANCE OF THE OCEAN SPORT FISHERY TO THE OCEAN CATCH OF SALMON IN THE STATES OF WASHINGTON, OREGON AND CALIFORNIA. California Fish and Game, Vol. 46, No. 3, pp. 291-300.

The ocean sport catch of both chinook and silver salmon has increased phenomenally over the past 10 years and is presently accounting for over 20 percent of the total catch. There is some indication that the percent sport catch may be stabilizing on chinook salmon. The sport fisherman is extending his season in time and is tending to move into the area that normally was fished only by the commercial troller. (Auth. summ.)

3633. Blunt, C. E., Jr., and James D. Messersmith. 1960. TUNA TAGGING IN THE EASTERN TROPICAL PACIFIC, 1952-1959. California Fish and Game, Vol. 46, No. 3, pp. 301-369.

Three vinylite tubing tags, Types E, F, and G, looped through the flesh immediately behind the second dorsal fin were tested during a field trial from October, 1952 to April, 1954. During this time, 4,204 yellowfin tuna and 2,839 skipjack were tagged. Based on recovery rates, the Type G tag was selected as the best.

With the marketing of an improved ink the protective outer jacket of the Type G "spaghetti" tag was removed in 1956. An improved yellow vinylite, Resinite X-270-I, was used in the construction of all tags starting with 1957.

Dart tags were field tested against the Type G tag in 1959. Skipjack returns were in favor of the dart tag.

From 1952 through 1959, 13,213 yellowfin tuna and 14,265 skipjack were tagged in the eastern Pacific. Of these, 263 yellowfin and 237 skipjack were recovered.

Both yellowfin tuna and skipjack moved north along the coast of Baja California during May, June, and July. By July some fish had started to move south and southerly movements continued through September and October.

There was an apparent interchange of yellowfin tuna between the Revilla Gigedo Islands and Baja California. For skipjack, however, the movement was one way--from the Revilla Gigedo Islands to Baja California.

Tag returns indicated the fisheries off Baja California, the Gulf of California and the Revilla Gigedo Islands are supported, in some degree, by yellowfin tuna moving north along the Mexican coast in winter and spring from at least as far south as the Gulf of Tehuantepec, and probably from as far south as Central America. This was not found to be true, however, for skipjack.

Yellowfin tuna and skipjack did not move between the Central American fishery and those off Peru and the Galapagos Islands. However, yellowfin tuna moved from the Galapagos Islands to Peru and skipjack moved from Peru to the Islands.

Yellowfin tuna and skipjack traveled between the Gulf of Guayaquil and the 14-Fathom Bank.

The Baja California-Revilla Gigedo Island area data were sufficient for annual growth rate estimation. Based on tagging, one-year growth rates for yellowfin tuna 440 to 750 mm. body length were 200 mm., 420 mm. and 350 mm. for 1953, 1955 and 1958 respectively. (Auth. summ.)

3634. Chadwick, Harold K. 1960. TOXICITY OF TRICON OIL SPILL ERADICATOR TO STRIPED BASS (*MOXOSTOMA SAXATILIS*). California Fish and Game, Vol. 46, No. 3, pp. 373-374.

Tricon Oil Spill Eradicator is toxic to striped bass at low concentrations. It is probable that lethal concentrations would occur at least locally, if the eradicator were used to treat oil spills.

3635. Gunderson, E. G. 1960. A RANGE EXTENSION OF THE CALIFORNIA HALIBUT (*PARALICHTHYS CALIFORNICUS*). California Fish and Game, Vol. 46, No. 3, pp. 373-374.

Meristic counts and measurements from a left-eyed *Paralichthys californicus* taken off Redding Rock, November 1959.

3636. Greeley, John R. 1960. A NEW 2,4-D AMINE PELLET FOR ERADICATION OF WATER CHESTNUT. Proceedings of the Fourteenth Annual Meeting of the Northeastern Weed Control Conference, January 6-8, 1960, pp. 488-495.

Amine pellets (10% 2,4-D acid equivalent) on 8-15 mesh hard attaclay gave effective control of water chestnut at approximate rate of application of 5 pounds per acre acid equivalent in areas not subject to rapid dilution. Treatment of water chestnut previous to flowering stage is recommended for best results in suppressing all seed formation. Bays should be treated rapidly to build up an even density of 2,4-D over the entire local area. Small patches in large areas of water will require higher rates due to diffusion into untreated water. Pellets are not recommended in tidal areas, in strong current or other areas where dilution is rapid.

3637. Saunders, J. W. 1960. THE EFFECT OF IMPOUNDMENT ON THE POPULATION AND MOVEMENT OF ATLANTIC SALMON IN ELLERSLIE BROOK, PRINCE EDWARD ISLAND. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 453-473.

During autumn spates Atlantic salmon (*Salmo salar*) commonly enter the small spring-fed streams of Prince Edward Island and spawn. Annual variations in freshwater discharge from Ellerslie Brook were found to determine the number of salmon and time of ascent. A pond formed on the brook created a habitat that exercised a strong retaining influence on the movements of spawners, kelts, parr, and migrating smolts. Smolts which stayed in the pond suffered heavy mortalities.

Movements by sexually mature male parr, within and between fresh and salt water, occurred in the fall. Some parr remained in the estuary in the

spring. Pond and stream smolts of the same age group were similar in size when they migrated. (Auth. abst.)

3638. Black, Edgar C., Anne C. Robertson, Arthur R. Hanslip, and Wing-Gay Chiu. 1960. ALTERATIONS IN GLYCOGEN, GLUCOSE AND LACTATE IN RAINBOW AND KAMLOOPS TROUT, *SALMO GAIRDNERI*, FOLLOWING MUSCULAR ACTIVITY. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 487-500.

Rainbow trout 1 1/2 years old (fall spawners) raised in the hatchery at Summerland, B. C., and 2-year-old mature spawning Kamloops trout (spring spawners) captured from Lake Okanagan, were subjected to 15 minutes strenuous exercise. Muscle glycogen was depleted in both groups. Following 30 minutes of moderate activity, muscle glycogen remained high in the 1 1/2 year-old trout. Liver glycogen levels were not significantly lowered during either strenuous or moderate exercise. Blood lactate levels were markedly elevated during 15 min. of strenuous exercise and continued to rise for 2 hours of post-exercise recovery in both groups of fish. In the 1 1/2-year-old trout, blood lactate declined to resting levels at about the 8th hour of recovery, and was increased 3-fold following 30 min. of moderate activity. Blood glucose and hemoglobin were not significantly altered during either strenuous or moderate activity.

In the 1 1/2-year-old trout, starvation of up to 7 days duration resulted in a marked depletion of liver glycogen. There was little change in muscle glycogen, blood lactate, glucose or hemoglobin, regardless of whether or not the fish had been exercised at the beginning of the starvation period. Feeding during the period of recovery from 15 min. of strenuous exercise resulted in increases in both muscle and liver glycogen levels. (Auth. abst.)

3639. Bell, M. C., and C. H. Clay. 1960. FACILITIES FOR ANADROMOUS FISH PASSAGE, PASSAMAQUODDY PROJECT. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 507-516.

Consideration was given to the effects of building dams at the entrance to Passamaquoddy Bay between New Brunswick, Canada, and Maine, U.S.A., on the normal migration route of anadromous fish. Situations at filling and emptying gates and at the proposed power house were assessed and provisions to facilitate normal movements of anadromous fish recommended. (Auth. abst.)

3640. Beeton, Alfred M. 1960. THE VERTICAL MIGRATION OF *MYTIS RELICTA* IN LAKES HURON AND MICHIGAN. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 517-539.

During the day *Mytis relictata* could be taken only near the bottom of Lakes Huron and Michigan. In the evening they migrated into the overlying strata as the surface light intensity decreased from 15 to 1 foot-candles. Frequently the mysids migrated

through the metalimnion when first ascending, but later in the night the majority occurred in or immediately below this layer. As the length of day decreased following the summer solstice, the mysids ascended progressively earlier each evening and descended later each morning (they descended when the surface light intensity was increasing from 10^{-3} to 10^{-2} foot-candle). Moonlight and fog influenced the extent and time of vertical migration.

The optimum light intensity for mysids is so low that they are concentrated near the bottom during the day. As the light decreases at sunset, they move upward rapidly; possibly because of a positive reaction to decreasing light. Their night-time distribution is determined by their response to the existing light and thermal conditions. Their dawn descent may be due to a photo-negative condition which originated during the night. (Auth. abst.)

3641. Martin, N. V., and N. S. Baldwin. 1960. OBSERVATIONS ON THE LIFE HISTORY OF THE HYBRID BETWEEN EASTERN BROOK TROUT AND LAKE TROUT IN ALGONQUIN PARK, ONTARIO. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 541-551

Studies of brook trout X lake trout hybrids planted in Algonquin Park, Ontario lakes since 1954 indicate they are readily available to angling and an excellent game fish. Hybrid trout depth distribution during stratification is between the 8° and 20°C isotherms. Mayfly nymphs, crayfish, leeches and fish are important in the diet. Hybrids average 12 inches at age II, 16 inches at age III, and 18 inches at age IV. Their length-weight relationship is similar to the lake trout. Most hybrids are mature by age III. Egg production is similar to the brook trout. Hybrids were observed spawning on rocky shoals in early November and had spawning characteristics of each parent. Hybrid trout eggs hatched by the end of April. (Auth. abst.)

3642. Chang, V. M., H. Tsuyuki, and D. R. Idler. 1960. BIOCHEMICAL STUDIES ON SOCKEYE SALMON DURING SPAWNING MIGRATION. XIII. THE DISTRIBUTION OF PHOSPHORUS COMPOUNDS, CREATINE AND INOSITOL IN THE MAJOR TISSUES. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 565-582.

The acid-soluble and fat-soluble phosphorus components, acid-soluble, lipid and total inositol and creatine content of the major tissues of sockeye salmon were determined at three locations during its river migration. With the exception of the gonads, these components were found in approximately the same concentration in the corresponding tissues of both sexes at the start of migration. The changes in total phosphate per unit weight during migration were most significant in the alimentary tract and liver of both sexes, and in the gonads of the female. Except for the gonads, the changes in inositol components were similar in both sexes. The same was true of the creatine content. In general, the tissues of the female were somewhat higher than those of the male in creatine, except in the gonads where milt con-

tained 6 to 7 times the amount found in roe.

The absolute amounts of the various components were calculated on the basis of the standard fish. A tissue component was sometimes markedly increased or decreased in absolute quantity in the standard fish, due not to a change in the concentration of the constituents but rather to an appreciable change in the weight of the tissue. This was especially true for the alimentary tract and roe. (Auth. abst.)

3643. McCauley, R. W. 1960. THE ROLE OF ELECTRICAL CONDUCTIVITY OF WATER IN SHOCKING LAMPREYS (*PETROMYZON MARINUS*). Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 583-589.

A plot of the critical voltage gradient required to immobilize a sea lamprey in water of 15°C, against the logarithm of the conductivity of the water, was described accurately by a rectangular hyperbola normal to the axes. The region of rapid change in critical gradient lies below a conductivity of 100 micromhos per centimetre cube. The average conductivity of a live lamprey at 15° was 2700 micromhos per centimetre cube. (Auth. abst.)

3644. Thomas, M. L. H. 1960. A MODIFIED ANCHOR DREDGE FOR COLLECTING BURROWING ANIMALS. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pp. 591-594.

An anchor dredge was modified so that it was to some extent self-sifting and so that its digging depth was adjustable. When towed for short hauls astern of a vessel, the dredge is an efficient qualitative sampling device for the fauna of soft bottoms. (Auth. abst.)

3645. McCauley, R. W., and D. P. Scott. 1960. REMOVAL OF FREE CHLORINE FROM RUNNING WATER BY SODIUM THIOSULPHATE. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 4, pg. 601.

The sodium thiosulphate is added continuously in the form of an aqueous solution by means of a constant-flow bottle. The amount of sodium thiosulphate required to neutralize the free chlorine was calculated by titrating a known volume of tapwater with a standard solution of the reagent. The strength of the solution in the constant flow bottle was calculated on the basis of a maximum concentration of free chlorine of 0.5 ppm. At this concentration, 1.5 g of sodium thiosulphate were required per day for a water flow of 1 litre per minute. By a suitable adjustment of the concentration of the solution and its rate of removal from the bottle, a gallon (about 4 l) of solution lasts a week before refilling is necessary. (Auth.)

3646. d'Ancona, Umberto. 1960. AN INTRODUCTION TO THE THEME AND A SUMMARY OF THE BACKGROUND AND EXPERIENCE PAPERS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 7-31.

This review paper has dealt with the conserva-

tion of living aquatic resources from the point of view of conservation of the habitat and the natural biological equilibrium.

Aquatic resources are continually endangered and damaged by the growing economic necessities of man in relation to industry, navigation, ways of communication in general and agriculture, and whenever possible, it is necessary to protect these resources, minimize injury, and provide substitutions for those that are damaged.

With respect to those effects of water and soil utilization projects that are harmful, it is important that the interests of those concerned with aquatic resources be respected as well as the interests of those concerned with industry and agriculture.

Whenever possible, it is best to preserve natural habitats and balances or modify them as little as possible and restore them if altered. However, if economic conditions impose radical changes on habitat and equilibrium, it is necessary to determine the most practical way in which they can best be substituted for by new habitats and new balances. In order to achieve this purpose, the natural environments must be studied carefully before carrying out any program of soil and water conservation because although much is known of the living aquatic resources, much research is still needed.

Furthermore, each environment has its own characteristics, so that there cannot be a general solution -- but each case must be studied separately.

A program for the protection of natural resources, integrated with all projects for the utilization of water for hydro-electrical, irrigation, industrial or other purposes, can prevent damage at the initial stage, and thus eliminate the need for subsequent remedies. (Auth. concl.)

3647. Larkin, P. A. 1960. THE EFFECT OF VARIOUS CONSERVATIONAL MEASURES OR WORKS ON THE AQUATIC ENVIRONMENT AND ON THE STOCKS OF THAT ENVIRONMENT. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 44-52.

Man's activities can change aquatic environments by:

- a) modifying factors which determine productivity;
- b) limiting the occurrence and abundance of aquatic organisms in general;
- c) limiting the occurrence and abundance of specific aquatic organisms.

The effects of any conservation measures or works should be gauged by consideration of which of these types of changes it will create or rectify. In general, headwater soil and water conservation programmes by regulating run-off and reducing siltation are usually beneficial to aquatic environments. Main stem dams may create new productive fishing areas but may also decimate runs of migratory fishes. Pollution control programmes almost invariably result in improvement in production of desired organisms. But both for these types of measures and for a number of other types of conservation projects the effects on aquatic environments cannot easily be predicted from general

principles or from experience elsewhere. Each project will have particular effects that can only be anticipated by detailed knowledge of the environment to be affected. Armed with this kind of information the aquatic biologist can suggest measures that will minimize harmful effects and capitalize on any opportunities for improvement. It will always be desirable to reassess the completed project and to revise programmes accordingly. Finally there is a continued need to seize upon these projects as opportunities for both applied and fundamental research. They represent experiments on a scale that is rarely available to the investigator. (Auth. concl.)

3648. Meehan, O. Lloyd. 1960. MULTIPLE PURPOSE PLANNING FOR AQUATIC RESOURCES. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 53-60.

Our experience to date in these and other situations involving natural aquatic resources clearly indicates that these valuable resources can be preserved provided they are given adequate consideration in the basic planning for conservation of other resources such as soil and water. Generally, aquatic resources are a non-consumptive use of water as opposed to consumptive use by irrigation, for example. Consequently, in the overall development of a river system a well-integrated programme for the benefit of aquatic resources does not detract from other uses of water. Without coordinated planning, the best efforts of fish and wildlife conservation agencies to preserve them may be futile. Because of the rapidly expanding use of water for industrial, irrigation, and other purposes, aquatic and wildlife resources will be greatly diminished if such planning does not take place.

Experience to date also emphasizes the need for including clear-cut authority for consideration in the basic authorities for all water conservation programmes affecting soil and water resources. Without such authority, truly multiple-purpose planning is rarely achieved. (Auth.)

3649. Runnstrom, Sven. 1960. HYDRO-ELECTRIC POWER STATIONS AND FISHING. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 61-68.

Fishing in Sweden, especially in the water-courses of Norrland, is greatly influenced by the extensive regulation of lakes and by the dams of hydro-electric power stations.

In connection with the regulation of lakes, the greatest effect is on the stock of fish which spawn in rapids, through the loss of places for their spawning and growth. The fluctuations in water level bring about an impoverishment of the bottom fauna, and the production of fish food drops. This results in the slower growth of fish. Fishing with nets is rendered difficult in the drowned woodlands. The division of rivers into stairways that results

from the power station dams damages the areas of spawning and growth of salmon. Extensive experiments with rearing and release of smolt are in progress, and experiments with marking have proved that it is possible by this means to maintain a stock of salmon in the sea. (Auth. summ.)

3650. Aass, Per. 1960. THE EFFECTS OF IMPOUNDMENT ON INLAND FISHERIES. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 69-76.

This paper discusses the effects of impoundment on fisheries in the following groups: Food and growth, propagation, migrations, size and composition of stock, and fishing.

3651. Somme, Sven. 1960. THE EFFECTS OF IMPOUNDMENT ON SALMON AND SEA TROUT RIVERS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 77-80.

This paper discusses the effects of impoundment for hydro-electric purposes on salmon and sea trout rivers.

3652. McGrath, C. J. 1960. DAMS AS BARRIERS OR DETERRENTS TO THE MIGRATION OF FISH. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 81-92.

The various ways in which the spawning migration of fish can be impeded, prevented or nullified by dams are discussed with reference to actual experiences with Atlantic salmon in Ireland. Proposals for overcoming some of the difficulties are discussed, in particular the improvement of entrances to fish passes for upstream and downstream migrants. (Auth. summ.)

3653. Royal, Lloyd A., and A. C. Cooper. 1960. DAMS AS BARRIERS OR DETERRENTS TO THE MIGRATION OF FISH. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 93-100.

The alteration a dam may cause to the existing river environment may be an extremely significant factor in deterring the migration of fish. The situations listed are not all-inclusive but are mentioned only to emphasize the necessity of evaluating the effect of a dam on the normal environment of the species of fish under consideration. Physical obstruction of the migration path is in fact only one aspect of the possible changes in environment. Where one or more dams are proposed for construction on rivers used by migratory fish, satisfactory means of preventing or overcoming these environmental changes must be found if the species of fish affected is to be maintained at optimum productive levels.

3654. Wiebe, A. H. 1960. THE EFFECTS OF IMPOUNDMENTS UPON THE BIOTA OF THE TENNESSEE RIVER SYSTEM. Seventh Technical Meeting,

International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 101-117.

The T. V. A. development has resulted in a vastly improved fishery in the Tennessee River Valley. The fishery has been expanded at least 50-fold, but more important, the quality - more fine fish desired by anglers - of the fishery has also been improved as a result of river impoundment. Special mention might be made here of the fine black bass (especially the northern smallmouth) and walleye fishery, the great increase in the crappie fishery, and the virtually explosive expansion of the sauger and striped bass fishery in the mainstream impoundments. The establishment of a large wintering population of ducks and geese is another tangible result of river impoundment. And although this later development required the use of lands beyond the reservoirs proper, the land without the reservoirs would not have effected this change. (Auth. summ.)

3655. Wood, Roy, and Donald W. Pfitzer. 1960. SOME EFFECTS OF WATER-LEVEL FLUCTUATIONS ON THE FISHERIES OF LARGE IMPOUNDMENTS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 118-138.

In view of limited scientific data with respect to the effects of water-level fluctuations on the fisheries of large impoundments, there has been much speculation. Concepts and experiments are reviewed in this paper as the basis for evaluating progress. Some of these concepts are illustrated by a discussion of Old River Lake, a natural lake subject to White River overflow, and Nimrod, Wheeler, and Norris Reservoirs, located on other tributaries of the lower Mississippi River, U.S.A.

Each of the described water areas is representative of a distinct type in the Southeastern United States; each has a different pattern of water-level fluctuation. Available fish population data for each area are related to season, frequency, stage, and duration of water-level fluctuations; also to topography of the reservoir basins.

Gross relationships in the light of previous experience and general knowledge, suggest that productivity, species composition, and ratios of predatory and forage, and game and rough fishes are influenced by water-level fluctuations. Effects on each of these characteristics depend more on extent, time, and duration of overflow above minimum-pool level than upon degree of water-level fluctuation as measured in vertical feet. It is also evident that these effects may be accentuated by topography, soil, and other factors.

Available evidence supports the concept that water-level fluctuation employed without discretion may be deleterious to some desired fishes; on the other hand, with sound application it may be one of the most effective tools in fishery management. (Auth. summ.)

3656. Maar, A. 1960. DAMS AND DROWNED-OUT STREAM FISHERIES IN SOUTHERN

RHODESIA. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 139-151.

1. Consideration is given to the development of fisheries in dams and drowned-out rivers of the tropical region, Southern Rhodesia.

2. From the minimum available useful water flow of 7.52 million acre feet in Southern Rhodesia, 650,000 acre feet is dammed already, and it is expected that an additional 2.9 million acre feet will be dammed soon.

3. For water storage there are established 8,078 dams in Southern Rhodesia, making a total of 45,000 acres, and 11 more dams with a total of 96,000 acres will be built in the near future.

4. Although the dams are built mainly for agricultural purposes, they are all suitable for fish culture. A substantial reduction of unfavourable aspects for fish culture in these dams is in most cases possible.

5. The natural fish production in dams is from 250 lb. to 1,000 lb. per acre a year. For fully controlled dams - << ponds >> - pond culture methods are appreciable and a production of over 5,500 lb. per acre a year can be reached.

6. The natural development of fish population leads at first to a predominance of predatory species followed by alternate periods of predominance of non-predatory and predatory species.

7. The following is essential for efficient utilization of a dam for fish culture:

a) All dams must have all three kinds of the main production fish: Tilapia mossambica, T. melanopleura and T. macrochir;

b) In addition to the mentioned Tilapia species, species of the Mormyridae family are recommended;

c) Only big species of the Labeo and Barbus (Cyprinidae) species are acceptable;

d) All predatory fish must be kept at the lowest possible level.

8. The growth of water plants is very rapid and intensive. Eradication of water plants is essential for fish production.

9. The spreading of malarian and bilharzia through water storage in dams is effectively controlled by intensive fish culture.

10. Fisheries in dams is one of the ways for a multi-purpose utilization of stored water. Fish production in storage dams of Southern Rhodesia may reach 28,000 tons a year. (Auth. summ.)

3657. Wales, J. H. 1960. THE EFFECTS OF WATER DIVERSIONS ON FISH. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 158-164.

Water diversions, of course, play an important part in fish and fisheries management throughout the world. The effects of diversions on fish are of two major types. When water is diverted the fish in the remaining portion of the stream are influenced. Usually the influence is harmful and much of the work of conservation agencies is directed toward preventing

total destruction of stream flows.

The other problem created by water diversions can be summed up in the two questions: «How can fish be prevented from entering diversions?» and «What can be done to conserve those fish that do enter the diversions?». Methods of screening or diverting fish away from the mouths of diversions will not be considered in this discussion, but we are concerned at this point with the fate of fish which have entered the conduits.

Let us summarize briefly the several things which may happen to fish that enter diversion conduits. They may be able to swim back out if they find the conditions disagreeable, but usually the velocity is too great or there is some mechanical obstruction to the return passage. In some cases the conduit ends in an industrial plant, perhaps a hydro-electric or steam generating plant; perhaps a factory, or a domestic water-purification plant. In cases of this sort there may be mechanical screens intended to remove all unwanted debris. By-passes can be a part of such structures and under ideal conditions the major part of the fish are diverted back to the water from which they originally came. In opposition to such short diversions are those extending for many miles, perhaps hundreds of miles, through which fish can be carried without harm. Conditions in these conduits will vary with each situation, each will have its own set of problems. Some conduits may be pipes through which fish are quickly swept. Others are similar to natural streams and fish may grow and even reproduce in them. In all cases, however, these conduits will be de-watered at intervals, and even though conditions usually may be satisfactory, when the conduit is drained dry of water the fish will be killed unless they are flushed into a natural stream or into a reservoir built to conserve them. Insofar as fish are concerned the essential difference between a conduit and a natural stream (of poor grade) is that conduits are periodically drained dry or practically dry.

Conservation efforts must be directed towards salvaging fish before they are stranded in drying conduits or before they are carried to some lethal environment. Some methods of salvaging fish are discussed in this paper. Essentially the problem is to provide places for rest and shelter along a canal where fish will tend to congregate. Such structures should be required for all conduit systems where fish are abundant. When the canals themselves are dewatered the fish can be salvaged in these refuge areas. In some cases they may be flushed back to natural waters or they may be fished out of the refuges. The construction of these fish refuges should include safety features to prevent accidents to humans and should be provided with access routes for fishermen. The proper construction of such refuges will require study but as more and more freshwater is diverted into conduits and reservoirs more effort should be given to recreational uses of diverted waters.

In addition to the problems already mentioned, water conduits often distribute fish over large areas

and into distant reservoirs, lakes and streams. Frequently this unintentional distribution of fishes is harmless or even beneficial but the manager must be aware of the possible introduction of highly undesirable species.

In conclusion it is evident that there are three broad problems raised by water diversions. First, the natural stream is reduced in flow by the diversion and this is often more or less harmful. Second, the aqueous environment of conduit systems is frequently harmful to fish, and devices are often needed to prevent fish from being carried to their destruction. Third, diversions often serve to distribute fish over wide areas and this can create serious problems for the fisheries manager. (Auth. summ.)

3658. Trautman, Milton B. 1960. DIVERSIONS, CANALS AND CONDUITS - THEIR ROLE IN INTRODUCING AQUATIC ORGANISMS INTO DRAINAGE BASINS WHERE THEY DID NOT RESIDE FORMERLY. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 175-184.

After reviewing some literature relative to various diversions throughout the world, it became evident that such diversions had many problems in common, that due to the antiquity of many Old World diversions it was impossible to evaluate accurately what had occurred, especially in the distant past, that many statements were based upon inconclusive evidence; therefore, this paper is restricted to some recently constructed canals in eastern North America with which the author has had considerable experience.

Completion of the Welland Canal in 1829 destroyed a long-time barrier between Lake Ontario and the remaining Great Lakes, making possible the invasion of aquatic organisms into the upper lakes. Invasions of the American eel, *Anguilla rostrata* (Lesueur), alewife, *Pomolobus pseudo-harengus* (Wilson) and sea lamprey, *Petromyzon marinus* Linnaeus are discussed. The lamprey invasion and its present catastrophic effects upon fish populations and commercial fisheries is described in detail.

The Ohio canals, twice crossing the State of Ohio and connecting the Ohio river and Great Lakes basins did not destroy a long-time barrier between the two basins, because since early post-glacial times many glacial outlets have existed through which aquatic organisms, especially fishes, could have passed from the Ohio River basin into the completely glaciated Great Lakes basin. Small connections between low divides were still in existence when the canals were built. Either indicates that no marked invasion from the Ohio River basin into the Great Lakes basin occurred, despite statements of the contrary made by early ichthyologists. The canals, and their large, supporting reservoirs, because of increase in amount of habitat, produced an abundance of food fishes, and resulted in an early commercial fishery. The canals, through extension of suitable habitats, enabled some fish species which were largely confined to northern Ohio, to penetrate the southern third of the state. Later the canals were largely abandoned and deterioration of habitats and other changing conditions elimin-

ated commercial fishing in the reservoirs. Today these reservoirs are important sport fishing areas. (Auth. summ.)

3659. Deelder, C. L., and D. E. Van Drimmelen. 1960. THE DECLINE OF THE FISH-STOCKS IN THE NETHERLANDS' SECTIONS OF THE RIVERS RHINE AND MEUSE. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 185-190.

This serious decline in the size of the fish stocks of these rivers reached a disastrous character in the first half of this century. It went hand in hand with a loss in natural character of the rivers, as a consequence of the various measures taken during the rapid industrialization of Western Europe. Continuous improvement of the navigability of the rivers became a necessity; measures were also taken to ensure a better control of water drainage. At a later phase, hydro-electric plants were constructed higher up in the rivers. Regulation of the river-beds and construction of weirs brought about a complete change in the character of the rivers. In the first half of the century more and more weirs appeared in the upper sections of the river Rhine and in most of its tributaries; in the river Meuse weirs have been constructed almost as far as its estuary. These weirs did not actually reduce the area for migrating fish, but made it in many cases completely impossible for them to reach their natural spawning grounds.

Water pollution, a result of industrialization, has also contributed to the decline of fish stocks. Several spawning grounds in the tributaries became so badly polluted that they could no longer serve as such. Local pollution in the river Rhine was so serious that sensitive species such as salmon could not survive in the affected area, so that the reaches upstream of the pollution became virtually inaccessible to them. (Auth.)

3660. Liepolt, Reinhard. 1960. DIE HYDRO-BIOLOGISCHEN AUSWIRKUNGEN DER GEWASSER-VERBAUUNG. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 205-214.

The physical, chemical and biological characteristics of water courses are greatly affected by construction works. Therefore, co-operation between engineers and hydrobiologists is essential to guarantee that optimum conditions with respect to these characteristics are maintained. Of fundamental importance here is the maintenance of some natural biotopes, and certain biocoenoses can even be improved by favourable changes in their biotopes.

A review is given of the importance of various physical, chemical and biological factors in the production of aquatic organisms and the changes brought about by different types of engineering works. The type of bottom most suitable for aquatic growth is described. The content of suspended mineral matter should be minimal to permit the

optimal transparency necessary for the photosynthesis of plants. Temperature has a great effect on biological processes and must be in a certain relation to the oxygen consumption of the water. Of all the chemical characteristics of water, the oxygen content is most important. It is necessary in some cases to provide artificial aeration. The biological aim should be to attain a biocoenosis rich in species and numbers and to achieve the highest self-purification capacity as well as a high productivity of fish.

A review is given of the materials and types of construction which will best benefit bodies of waters from a biological standpoint. As a substitute for the use of concrete, embankments may be strengthened through the use of loose stones and tree planting. Velocity of water may be decreased and bottoms improved through provision of small steps.

Barriers and dams cause considerable changes in water courses, and the results may or may not be favourable. For example, they decrease the rate of flow and thus may increase production. On the other hand, they may destroy the spawning grounds of many fish. Fluctuations of water level are usually unfavourable to fish populations. Fish migrations are usually blocked or greatly deterred. In Austrian rivers, natural fish passes have been constructed by using ramps composed of large stone blocks - the so-called Riedinger-Schauberger method.

Timely planning and adequate consideration of hydrobiological needs in choosing the type of construction and building materials is of the utmost importance. (Auth. summ.)

3661. Sylvester, Robert O. 1960. SOME INFLUENCES OF MULTI-PURPOSE WATER USAGE ON WATER QUALITY. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 215-235.

A brief resume has been presented on portions of a water quality study that was made in the Columbia River Basin by the University of Washington for the U.S. Fish and Wildlife Service. Water quality constituents evaluated (only a portion of those determined are shown herein) were those that might relate to the productivity of the River Basin fishery. The natural Basin water quality has experienced a significant change in the past 45 years through the construction of multi-purpose and single-purpose dams. After these dams were built, water was available for agriculture, industrial and domestic consumption. It is the spent waters from these consumptive uses, more than the dams themselves, that have produced this water-quality change. From the standpoint of the fishery, the seemingly most important component of water quality at this time is that of temperature. Water temperatures in the central Columbia and in the lower Snake and Yakima Rivers are high during the summer. Dissolved constituents have shown a marked rise during the past 45 years but have not risen to the extent that the fishery is endangered, according to data presently available. Dissolved oxygen values are high throughout the Basin, with the exception of the lower Willamette River. With the usage

of more complex organic and inorganic compounds in the home and in industry, it can be expected that present criteria for water-quality evaluation will have to be expanded in the future. (Auth. summ.)

3662. Liebmann, H. 1960. THE INFLUENCE OF SEWAGES ON FISHERIES. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 236-241.

Sewages may harm fish by: (1) toxic influence; (2) oxygen depletion; (3) shift of biological balance; and (4) storage of taste-influencing substances in fish flesh. (Auth.)

3663. Tarzwell, Clarence M. 1960. EFFECTS AND CONTROL OF STREAM POLLUTION. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 242-252.

It is customary for man to dump his wastes into streams. Since water is a universal cleansing agent and many wastes are water solutions, it is to be expected that wastes will continue to be discharged into streams and will be impossible to eliminate totally from water courses. Abatement should be directed toward maintaining waste concentrations below levels harmful to the beneficial uses of the streams. Water resources are not only valuable but essential to continued existence. The principle of multiple use must be given more than lip service and must be earnestly applied if water supplies are to meet increasing demands. The discharge of sewage and industrial wastes into streams is not the sole cause for the declining value of our aquatic resources. Misuse of watersheds is an outstanding cause. Water and land resources are interdependent entities and good land management is a prerequisite for good water management.

Water quality criteria must be established and enforced if the favoured beneficial uses of our waters are to be preserved. These criteria of standards must be based on knowledge of the minimum requirements essential for the protection of each beneficial use. Cooperation among the various agencies concerned with water resources and water uses is vital if supplies are to be protected and the most beneficial uses given preference in the setting of criteria. All uses must be recognized and the greatest good to the largest number over the longest time should be the determining factor in a decision on the highest uses of any aquatic resource. Aesthetic and recreational uses have great economic value and are increasing in importance. Increasing interest in aquatic sports demands increasing concern for these water uses. While water quality criteria are largely undeveloped for some uses, considerable progress has been made in the setting up of criteria for aquatic life. A knowledge of the environmental requirements of the species to be protected is basic to the establishment of such criteria. While much remains to be learned, the data now at hand can be used effectively to meet existing problems. (Auth. summ.)

3664. Muus, Bent. 1960. THE INFLUENCE OF DRAINAGE WORK AND RECLAMATION ON STOCKS IN DANISH ESTUARINE WATERS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 265-270.

Reclamation projects are being examined on four different planes:

1. A quantitative investigation of the micro-flora, especially diatoms, with production determinations of photosynthesis as well as of the growth and amount of the higher plants.

2. A quantitative examination of the fauna attached to bottom and vegetation and which serves as food for, or competes with, the fish fauna.

3. An attempt at determining the number of fish, the possibilities of growth and other biological conditions of the various species of fish.

4. On the basis of statistical information from the fisheries, to arrive at a figure for the value to the fishing industry of the area investigated and to compare this with a similar figure obtained as a total result of the first three items of the investigation. (Auth.)

3665. Dill, William A., and G. L. Kesteven. 1960. METHODS OF MINIMIZING THE DELETERIOUS EFFECTS OF WATER- AND LAND-USE PRACTICES ON AQUATIC RESOURCES. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 271-307.

The table of contents lists: The biological objectives; the practical techniques - minimizing the effects of dams or other barriers on upstream or downstream movement; passing upstream migrants; passing downstream migrants; minimizing the ill-effects of changes in flows below dams; temperature; water quality; minimizing the ill-effects of changes in depth or water fluctuation above dams; prevention of fish loss in diversions; prevention of harm from exotic organisms introduced through diversion; reducing the ill-effects of drainage, dredging, modifications of stream courses and similar practices; the prevention and control of water pollution; substitution of artificial methods as a replacement for reduced natural propagation; the improvement of habitat in new waters and the management of their stocks; policy, the problem of reconciling conflicting objectives.

3666. Lindroth, Arne. 1960. ANADROMOUS FISH CONSERVATION IN A SWEDISH SALMON RIVER. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 308-315.

Appendix 2 is a simplified plan, highly schematic, for the taking over of the former natural fish production in the river by Bergforsens's salmon-rearing station.

It is true that experiments have not yet provided evidence of the possibility to maintain large stocks of anadromous fish unimpaired by the complete incapacitation of the whole home rivers. However, in the light of Swedish activities in recent years in this field, there seems to be no reason to doubt a final success for these

conservation schemes, forced into operation by the social and industrial need for energy.

3667. Deelder, C. L. 1960. CONSERVATION OF ELVER MIGRATION ROUTES INTO THE INLAND WATER SYSTEM OF THE NETHERLANDS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 321-322.

Elvers are quite willing to migrate against a freshwater flow along the sea bottom, and not exclusively in the surface layers as was hitherto presumed. On the basis of this information, a new procedure will be put in operation from 1958 onwards; during low tide the hatches of the sluices will be raised a few centimetres only, so that a continuous flow of freshwater will pass the hatches on its way to the sea along the bottom of the sluices.

Extensive and large-scale aquarium experiments have revealed that in such a situation elvers will be attracted by the fresh water and will assemble in front of the hatches. As soon as the velocity of the freshwater flow diminishes sufficiently - owing to the rise of the sea level at flood tide - all elvers will make for the fresh water of the IJsselmeer. As soon as the sea level is equal to that of the lake the hatches will be closed, thus preventing the salt water from flowing into the lake. By this procedure the elvers will easily reach the lake without a simultaneous infiltration of considerable quantities of sea water.

3668. Van Someren, Vernon D. 1960. FISHERY PROBLEMS CREATED BY WATER UTILIZATION PROJECTS IN SCOTLAND AND EAST AFRICA. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp.323-336.

This paper deals with problems affecting Atlantic salmon stocks in Scotland, arising from hydro-electric power development of rivers, and secondly with those affecting commercial river fisheries in Kenya Colony arising from irrigation projects.

In the former case it is emphasized that basic knowledge concerning the normal dynamics of salmon population is very scanty, so that the effects of alteration of their river environment cannot yet be truly assessed; and there is at the same time a similar lack of knowledge concerning the biology of the river stages which would have been most useful in designing and operating such power constructions to mutual advantage. The urgency of development has outrun the fundamental research necessary.

In East Africa, major irrigation projects affecting commercial fisheries are still only in the proposal or early construction stages, so that research is being actively pursued to determine the features of normality, which will safeguard the fisheries before it is too late. Entirely different types of migratory fish are involved, whose biology and behaviour so far as known will necessitate different arrangements to those required for salmon.

Certain principles are however basic to both,

such as design and siting of efficient fish passes and screens, and major differences will lie in the actual method of utilization of the water in each case.

A brief review is given of problems arising with salmon in relation to the actual design of power installations as regards ascent and descent of fish, and also in relation to methods of station operation as they affect the migrating fish. Provisions made to ensure adequate ascent of adult fish are generally more satisfactory than those for the young descending stages, which still require a good deal of experimentation, and are equally important. Some suggestions are offered for improving such facilities based on observations already made. The efficiency of methods for artificially maintaining stock cannot yet be assessed, but have been applied in relatively few instances.

As far as irrigation projects are concerned, while satisfactory passes and screens are required, the main requirements will be to operate the schemes so as to suit the spawning habits of the fish concerned, and continuous, as opposed to intermittent, irrigation is essential, as in the culture of water crops such as rice. Irrigation of areas given over entirely to dry-foot crops will inevitably damage fisheries. Considerable attention will also be paid to the alterations which will be required in existing indigenous fishing methods, which at present may conflict with flood control. The institution of irrigation may however to some extent increase the total fishery potential if properly managed. (Auth. summ.)

3669. Stuart, T. A. 1960. THE INFLUENCE OF DRAINAGE WORKS, LEVEES, DYKES, DREDGING, ETC., ON THE AQUATIC ENVIRONMENT AND STOCKS. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 337-345.

This paper deals primarily with the consequences to salmonid stocks, their food supplies, shelter, access to and from spawning grounds, following upon drainage activities, etc. Both beneficial and deleterious effects of drainage works are examined and compared with conditions obtained in natural systems. The possibility of combining the desirable features of both systems with a view to conservation and improvement of stocks in artificial channels is discussed and suggestions are made and experiments described which endeavour to achieve this result without interference with, but possibly with benefit to, other legitimate uses of land and water. (Auth. summ.)

3670. Clay, C. H. 1960. THE OKANAGAN RIVER FLOOD CONTROL PROJECT. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 346-351.

The Okanagan River Flood Control is an example of achievement of desired measures of flood control without harm to anadromous fish utilizing the river. Flood control was achieved by construction of storage dams in the headwaters, channel improvements in the lower reaches, and use of so-called «drop structures» for dissipation of energy in the improved channel. The natural environment of the anadromous fish utilizing

the river was protected and possibly will be improved by designing the project to maintain the required original physical conditions during the spawning and incubation periods, and by providing ready access over the crop structures to the spawning areas above. (Auth. summ.)

3671. Worthington, E. B. 1960. THE INFLUENCE OF SOIL AND WATER CONSERVATION ON NATURAL AQUATIC RESOURCES. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 363-364.

The object of this paper was to examine and elaborate, with reference to selected catchment areas, the general principles which had emerged from the background papers for Theme Id.

The main example was the river Nile of which the catchment is shared by eight countries. From a scientific viewpoint this is one of the best-known rivers of the world with records of flow, unfortunately not continuous, dating from the early civilizations of Egypt. A quantity of modern information is now available through the activities or organizations such as the Physical Department of Egypt, the Irrigation Department of the Sudan, the Hydrological Survey of Uganda, the East African Fisheries Research Organization, the Game and Fisheries Department of Uganda, the Hydrobiological Unit of University College Khartoum, the Jonglei Investigation Team and the Fisheries Section of the Game Department in Sudan.

The accidents of geological history, including the formation of rift valleys, the pluvial and interpluvial periods, river capture and erosion, have achieved in the Nile system a remarkable amount of natural water conservation. For instance there are the vast natural reservoirs of Lakes Victoria, Edward and George, Albert, Tsana, which help to control the river's flow. This water control, coupled with natural soil erosion of prodigious dimensions in Ethiopia, made possible the ancient and modern civilizations of Egypt and the Sudan. It has also led, through varying degrees of isolation, to the evolution of aquatic fauna, especially fishes, which are of great interest to evolutionary biologists and are fundamental to the proper use of the aquatic resources.

Most scientists who have been concerned with the conservation and use of the Nile's water resources are in broad agreement with a master-plan for improving on the natural system of water-storage and water-flow in different parts of the river system, in the interests of all inhabitants of the countries concerned. The various measures are, however, still being debated actively on the political level and there may be long delays before final decisions are reached. The influences on aquatic and related natural resources of those works already completed (Owen Falls Dam, Jebel Aulia Dam, Sennar Dam, Aswan Dam) and of those which may be undertaken in future (Lake Kioga Barrage, Lake Albert Dam, Lake Tsana Barrage, Blue Nile (Roseires) Dam, Aswan High Dam) were examined as also were the

increased and reduced amount of soil in different parts of the catchment, consequent on the activities of mankind in exploiting or conserving the soil and vegetation. On the whole, the conservation of Nile waters increases the potential of the aquatic resources. In this connection, however, it is important to distinguish between the quantity and the quality of water which may be held in storage or released down the river, as influencing biological productivity. Such influences extend, in the case of big rivers, into the sea; the progressive reduction in the Nile's effect in fertilizing parts of the Eastern Mediterranean is a case in point.

Other catchment areas were compared with the Nile. The Volta river project in Ghana and Kariba Gorge hydro-electric scheme in Rhodesia will create lakes on the rivers Volta and Zambezi respectively which in size and biological potential will be comparable with the Great Lakes of East Africa, but they will be situated in parts of the continents which are conspicuous for the absence of standing water. Both these projects provide opportunity for the development of substantial aquatic resources through wise scientific management, but at the same time they will involve other biological changes, including risks to health, which need to be woven into a new ecological pattern.

Nearer at home, on the much smaller scale of catchment areas in the British Isles, where until recently water has been thought of as abundant in supply, many new projects are having pronounced biological influence. Often the situation is dominated by water pollution, the prevention or cure of which presents problems so intense that they can be tackled only on the scale of pilot areas. In one case, that of Milford Haven in South Wales, where major industrial developments are to take place in an estuary and a catchment of pure water, it is hoped that arrangements can be made to demonstrate that, by applying the resources of modern knowledge, industrial development and the purity of water are not incompatible. (Auth. summ.)

3672. Pentelow, F. T. K. 1960. POLLUTION CONTROL AND WATER CONSERVATION. Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Theme I, Volume IV, pp. 365-370.

In Great Britain the problem we are now facing is not in most cases how to purify an effluent but a quantitative assessment of what degree of purification is necessary. It is a question of economics. Purification is an expensive process and the greater the degree of purification the more steeply the cost rises. We are now trying to find out what is the capacity of our rivers to absorb waste waters without damage to their use for water supply, fisheries, agriculture and industry.

It is also necessary that there should be administrative and legislative arrangements so that water users are encouraged or even compelled to take the best available methods to avoid the discharge of polluting effluents, and it is a great advantage if arrangements are sufficiently flexible to allow of the

rapid application of new advances in the techniques of water purification. In Great Britain we are fortunate that new laws designed «for maintaining or restoring the wholesomeness of the rivers and other inland or coastal waters» were passed in 1951 and that over the greater part of the country the administration of these laws is the responsibility of River Boards which have jurisdiction over a whole catchment area or a group of catchment areas. The system seems to be working well and though progress in restoring the wholesomeness of some of our waters is not so rapid as we could wish, the reasons are primarily economic and not technical or administrative. (Auth.)

3673. Larsen, Knud. 1955. FISH POPULATION ANALYSES IN SOME SMALL DANISH TROUT STREAMS BY MEANS OF D. C. ELECTRO-FISHING. Meddelelser Fra Danmarks Fiskeri-Og Havundersøgelse, Ny Serie, Bind I, Nr. 10, 69 pgs.

The major topics discussed are: methods used for the judgment of the fish populations of streams prior to the introduction of electro-fishing; electro-fishing and the methods used in the present investigations; the localities investigated, the composition of species in the fish populations and the number of fish per Are (100 sq. mi.); age groups of the trout population in the small streams and fluctuations in the size of the trout population and the reduction of the individual year classes.

3674. Nauwerck, Arnold. 1959. ZUR BESTIMMUNG DER FILTRIERRATE LIMNISCHER PLANKTONTIERE. Arch. f. Hydrobiol. /Suppl., Falkau-Schriften, XXV, IV, 1, Stuttgart, August, pp. 83-101.

1. As a first result of an investigation on the interrelation between primary production and primary consumption in Lake Erken (Sweden) a method is described for the determination of the filtration-rate of the herbivorous zooplankton. The method is built on the C^{14} -technique usual for the determination of the photo-synthesis of phytoplankton. It enables experiments "in situ".

2. It is shown that *Eudiaptomus graciloides* feeds more in light, but never completely stops filtering. The filtration-rate is established as fluctuating between 0,3 ml and 2,8 ml/animal/day. It depends in the first place on the motion activity, which is directed by light conditions, temperature and sexual cycle. Adult females filter more than males, egg-bearing females showing the highest filtration-rates.

3. *Daphnia longispina* v. *hyalina* appears as feeding essentially at twilight. Filtering is here also never completely stopped. The filtration-rate is directed by the same factors as on *Diaptomus*. It differs between 0,2 ml and 4,5 ml/animal/day. The most important factor is the temperature.

4. Some values for filtration-rates of *Bosmina*, *Ceriodaphnia*, *Diaphanosoma* and mixed populations of rotatoria are given. For the first three species they are estimated at about 1,0 ml/animal/day, for

the rotatoria at between 0,003 ml and 0,043 ml/animal day.

5. Objections against the method are discussed. Experiments resulted in an average variation of less than $\pm 20\%$.

6. *Eudiaptomus graciloides* is compared with the related *Calanus finmarchicus*. Except for the preference of filtering in light of *Diaptomus* there is a vast coincidence with the facts established by the marine biologists on *Calanus*. (Auth. summ.)

3675. Forsberg, Curt. 1959. QUANTITATIVE SAMPLING OF SUBAQUATIC VEGETATION. Oikos, Vol. 10, Fasc. 2, pp. 233-240.

1. In order to get exact unit areas of subaquatic vegetation for investigations on standing crops and productivity, a new way of sampling has been tried. Taking the samples from above involves destroying parts of the vegetation. The new sampler takes the vegetation from below. The sampler has been constructed for luxuriant subaquatic meadows on soft bottoms.

2. Investigations on *Myriophyllum verticillatum* and *Nitella mucronata* in Osby Lake, Djursholm, show that the maximum values of the oven-dry weight are 240 and 310 g/m². The highest productivity data are 2.8 g/m²/day for *M. verticillatum* and 2.5 for *N. mucronata*. In the autumn the data are negative: *M. verticillatum* - 1.3 and *N. mucronata* - 0.9 g/m²/day. Then decomposition and dissimilation are greater than assimilation. (Auth. summ.)

3676. Cooper, Edwin L. 1959. TROUT STOCKING AS AN AID TO FISH MANAGEMENT. Pennsylvania State University, College of Agriculture, Agricultural Experiment Station, Bulletin 663, 21 pgs.

Artificial propagation and stocking of brook, brown, and rainbow trout is one of the oldest and best known tools of fish management in the United States. Sufficient information about the technology of fish culture and the ecology of natural trout populations is now available to assure satisfactory management of this resource.

An accurate appraisal of the desires of the angling public has seldom been made. Opinions as to the type of trout management wanted range from one extreme of "no stocking; fish for fun only" to the other of "completely artificial propagation-put-and-take fishing."

The emphasis and publicity accorded propagation and stocking often has belittled the greater contribution of natural trout populations in furnishing both recreation and fish in the creel. The low survival rates of both hatchery and native trout, although consistent with the high reproductive potential of these fishes, usually are sufficiently high to allow a large exploitation of the residual population by anglers without danger of depletion of the fish stocks.

Regulation of fishing historically has been considered an important part of trout management. Many regulations, such as a minimum size, daily bag, or closed season, either are too liberal to afford much protection to native populations, or have little application to modern put-and-take stocking programs. Differences in catchability among trout species also make it diffi-

cult to manage this resource by means of blanket-type regulations.

Further advances in managing trout resources are more likely to occur when fishery biologists clearly recognize the essential differences between native trout populations and domesticated hatchery trout. It is unlikely that fish which have been selected for numerous generations to perform in a superior manner under hatchery conditions will maintain characteristics of behavior, physiology, and anatomy which will enable them to survive in a natural environment at the same rate as wild fish.

Based on a large number of trials by different investigators, the best returns from planted trout are likely to occur:

1. When trout of any size are stocked in suitable lakes, ponds, or streams where there is little or no competition from fish already present in the water, or

2. When catchable-sized trout are stocked in streams where and when heavy fishing pressure is exerted promptly after stocking. (Auth.)

3677. Van Campen, Wilvan G. 1960. JAPANESE SUMMER FISHERY FOR ALBACORE (GERMO ALALUNGA). U. S. Fish and Wildlife Service, Research Report 52, 29 pgs.

The important albacore fishery carried on by a fleet of Japanese live-bait tuna boats in the spring and early summer in the northwestern Pacific is described. An account is given of the historical background of the fishery, and the magnitude of its production is compared with other Japanese albacore fisheries and with the United States west coast fishery. The seasonal trends in landings, geographical distribution of bases and fishing grounds, and the marketing and utilization of the catch are discussed. The fishery is shown to be the largest in the world for this species, although only a recent outgrowth of, and still subsidiary to, the Japanese skipjack fishery, and to be largely dependent on foreign markets for its support.

3678. Cottam, Clarence. 1958. WILDLIFE AND WATER CONSERVATION. J. Soil and Water Conserv. 13: 65-69; Abstracts, Agricultural Research Service, U. S. Department of Agriculture, Number 17, pg. 128. 1960.

Good soil and water conservation is no less a prerequisite for sustained and successful agricultural crop yield than it is for wildlife production. Wildlife is a product of the land just as much as is corn, cotton or livestock.

Poor hunting and fishing are as characteristic of poor land as are the scanty agricultural crops produced. Wild animals abhor wornout, eroded and abandoned farm land because of inadequacy of food and cover and because the mineral fertility of food nutrients is too low to sustain them in health. Successful wildlife management must start with the soil.

Much progress has been made, and the Soil Conservation Service and local conservation groups deserve great credit for helping to improve wild-

life habitat throughout the country by means of sound soil and water conservation practice. Sound wildlife, soil and water conservation programs are inseparable.

3679. Hutchinson, James A., and Morris White. 1959. OWNER EXPERIENCES WITH FARM PONDS IN EAST-CENTRAL ALABAMA. Agr. Expt. Sta. of the Ala. Polytech. Inst. C. No. 129; Abstracts, Agricultural Research Service, U. S. Department of Agriculture, Number 17, pg. 129. 1960.

The 470 ponds in Lee County, located in east-central Alabama, contain about 2,200 surface acres of water. About 320 of them are private ponds and contain 1,640 surface acres, or 13,000 acre feet of water.

Government agencies rendered valuable assistance to pond owners in planning, constructing, and managing ponds. Eighty-six per cent of the sample pond owners received technical assistance from government agencies.

Per acre cost of constructing noncommercial ponds was inversely related to pond size, and ranged from a low of \$211 for large ponds to \$590 for small ponds. Ponds used for irrigation had the lowest average per acre cost of construction, \$203. Average per acre cost of construction of all sample ponds was \$268. None of the pond owners reported receiving financial aid for pond construction from governmental agencies.

Annual costs varied from a low of \$7.24 per surface acre for commercial ponds used for irrigation to \$30.81 for ponds used by clubs. Annual costs were about \$30 for 4 of the 6 groups of ponds. Groups for which average annual per surface acre costs were most different were large noncommercial ponds with costs of \$10.98 and irrigation ponds with costs of \$7.24.

Ponds rented to clubs returned a net income of \$75 per surface acre.

Net returns to owners who sold fishing permits averaged \$14.80 per surface acre when no charge was made for family labor involved in selling permits. When the prevailing wage rate was applied to the hours of family labor involved, these ponds showed a deficit in net returns.

The estimated net return per acre-inch of water applied to pastures, small grains, and silage was \$0.51, and for cotton, \$6.48.

Owners of small ponds reported an average catch of 192 pounds of fish in 290 hours of fishing per surface acre of pond. An average of the reports from owners of medium-size ponds showed 135 pounds of fish caught in 80 hours of fishing per surface acre.

Five of the 6 groups of ponds yielded profitable monetary returns to their owners.

3680. George, John L. 1959. EFFECTS ON FISH AND WILDLIFE OF CHEMICAL TREATMENTS OF LARGE AREAS. J. Forestry 57:250-254; Abstracts, Agricultural Research Service, U. S. Department of Agriculture, Number 17, pg. 130. 1960.

The history of field investigations of the effects of DDT on wildlife is reviewed briefly, from the initial studies in 1945 through the more recent studies

of the effects of a large-scale program for spruce-budworm control and gypsy-moth eradication. DDT dosages and procedures that are recommended for protection of wildlife are reviewed. Effects of aldrin, heptachlor, and toxaphene are discussed in connection with the grasshopper and Mormon cricket control programs. Delayed and indirect effects of chemical treatments are emphasized as an important current problem. Cited in this connection are fish losses in the Yellowstone and Miramichi rivers and losses of wildlife from eating earthworms a year after treatment of the area with DDT. Currently recommended procedures to safeguard wildlife in pesticidal programs are listed.

3681. Burdick, G. E., H. J. Dean, and E. J. Harris. 1960. EFFECT OF SEVIN UPON THE AQUATIC ENVIRONMENT. New York Fish and Game Journal, Vol. 7, No. 1, pp. 14-25.

Sevin (1-naphthyl-N-methyl carbamate) was sprayed by airplane at a rate of 1 1/4 pounds per acre in fuel oil with a paraffin oil sticker on an area near Oneonta (N. Y.) and its effect upon the aquatic fauna of two streams was studied. Square-foot samples collected before and shortly after spraying showed reductions of from 48.9 to 97.2 per cent in weight of invertebrate fish food. Percentages were computed by the method of Hoffman and Surber (1948) which uses an upstream, untreated station as a corrective. On one stream additional samples were taken nearly a month after spraying, and little recovery could be observed.

The adverse effect was also noted from the large numbers of floating insect nymphs and larvae collected on screens during periods coincident with the passage of water containing spray residues through the various sampling stations. A method is discussed by which this method of sampling could be placed on a quantitative basis.

No mortality among any fish species present in these waters at the time of spraying was observed. (Auth. abst.)

3682. Lindsey, James J. 1960. PELLETED DRY FOOD AS A TOTAL DIET FOR TROUT. New York Fish and Game Journal, Vol. 7, No. 1, pp. 33-38.

The effects of feeding a total diet of pelleted dry foods to brook trout and brown trout were compared with those of a pellet diet supplemented with meat. Nine pairs of hatchery ponds in six hatcheries were used in the experiment which ran from November through April. No significant differences between diets were found for conversion, gain in weight or mortality. The all-pellet ration was found to be more economical in both labor and cost. (Auth. abst.)

3683. Haskell, D. C., R. Davies, and J. Reckahn. 1960. EFFECT OF SORTING BROWN TROUT ON SEX RATIO AND GROWTH. New York Fish and Game Journal, Vol. 7, No. 1, pp. 39-45.

Unsorted samples of brown trout fingerlings had an approximately 50:50 Sex ratio. Length and weight data according to sex for a small group of

brown trout were taken over a period of a year. The rate of growth, as measured by increases in length or in the cube root of the weight, was found to be nearly the same for males and females. It was nearly the same for the groups produced by sorting. Although the average growth rate was approximately the same for groups of different size, great variation was observed among individual fish, so that the effect of sorting was only temporary in producing groups of uniform size. Selection of the largest fish by length or weight at a given age was found to have little value in predicting their subsequent growth rate. (Auth. abst.)

3684. Loeb, Howard A. 1960. REACTIONS OF AQUARIUM CARP TO FOOD AND FLAVORS. New York Fish and Game Journal, Vol. 7, No. 1, pp. 60-71.

The reactions of carp to 115 flavors and many types of food were observed at the State Fish Laboratory at Livingston Manor. The test fish detected all the oils and a number of water-soluble flavors, but not alcohol and salt. Several water-soluble compounds stimulated feeding activity in blind fish although the fish were unfamiliar with them.

Tests indicated that adult carp will accept almost all foods without regard to color but will not eat those they cannot crush with their pharyngeal teeth. Ability of blind carp to catch some fast-moving animals was demonstrated.

Observations of feeding activities revealed a complicated but stereotyped set of actions, with certain senses dominant over others at times. Sympathetic activity among the senses was also revealed. (Auth. abst.)

3685. Cooper, A. L. 1960. LETHAL OXYGEN CONCENTRATIONS FOR THE NORTHERN COMMON SHINER. New York Fish and Game Journal, Vol. 7, No. 1, pp. 72-76.

Mean lethal oxygen levels for the northern common shiner (*Notropis cornutus frontalis*) were determined at several temperatures from 55° to 80° F. The mean values ranged from 0.54 to 1.23 p.p.m. and gave a straight-line curve when plotted on semi-logarithmic paper.

The test procedure involved placing each fish in a closed container and obtaining a gradual reduction of the oxygen content of the ambient water by the respiratory activities of the confined fish. Residual oxygen concentrations were determined for the water in each container when the test fish was completely over on its side with barely perceptible gill movements. (Auth. abst.)

3686. Bernhardt, Robert W. 1960. EFFECT OF FYKE-NET POSITION ON FISH CATCH. New York Fish and Game Journal, Vol. 7, No. 1, pp. 83-84.

It may be concluded that a fyke net, set parallel to the bottom contours in these lakes, will on the average catch more fish than one set perpendicular. The percentage increase in catch of the parallel set, however, will not be constant from one fishing period to the next.

3687. Mullan, James W., and William A. Tompkins. TROUT POND MANAGEMENT IN MASSACHUSETTS. Massachusetts Division of Fisheries and Game, 132 pgs.

Major topics discussed are pond dynamics, trout requirements, the trout pond resource, trout management policy, and action programs and recommendations.

3688. Willen, Torbjorn. 1959. THE PHYTOPLANKTON OF GORVALN, A BAY OF LAKE MALAREN. *Oikos*, Vol. 10, Fasc. 2, pp. 241-274.

The present investigation of the qualitative and quantitative phytoplankton composition of Gorvaln, a bay of Lake Malaren, forms part of a team investigation involving the chemistry of the water and phytoplankton production, carried out during the period 16/V 1955 to 28/V 1956.

The plankton algae have been identified in the living state or on material preserved with I_2 + KI-acetic acid or formalin. Plankton counts have been conducted according to Utermohl (1931, 1958) using an inverted plankton microscope. Supplementary chemical and physical data are included (cf. Sikstrom 1956 and Rodhe in prep.).

The spring water circulation in 1956 was not complete, because of a previous powerful inflow of brackish water from the Baltic (cf. Figs 1-3 and Tables 2-3). Because of the extra nutrients (principally phosphates) introduced by this brackish water, the phytoplankton development in the spring of 1956 considerably exceeded that of 1955 (Fig. 9). Fig. 10 shows the volumetric constitution of the phytoplankton during the year, divided up among the different groups of algae.

The composition of the phytoplankton is commented upon in connection with Figs. 4-8. The occurrence of conidia of certain hyphomycetes among the plankton is recorded.

Nannoplankton algae clearly dominate, both numerically and volumetrically, over netplankton algae, except when high production of filamentous diatoms and cyanophytes occurs. (Auth. summ.)

3689. Fish, Charles J., and Associates. 1960. LIMNOLOGICAL SURVEY OF EASTERN AND CENTRAL LAKE ERIE 1928-29. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 334, 198 pgs.

Results of a cooperative survey of the central and eastern basins of Lake Erie in 1928-29 by the U. S. Bureau of Fisheries, New York State Conservation Department, Ontario Department of Game and Fisheries, Health Department of the City of Buffalo, and the Buffalo Society of Natural Sciences are presented in a series of papers. Physico-chemical data include seasonal, vertical, and horizontal variations in temperatures, water movements, dissolved oxygen, carbon dioxide, phenolphthalein and methyl-orange alkalinity, pH, chlorides, and turbidity. The species composition, seasonal abundance, and distribution of micro- and macroplankton are discussed in detail. Special

consideration is given to the influence of polluted river waters which flow into the lake.

It is concluded that the lake is remarkably free from chemical and sewage pollution. Evidence of pollution farther than 1 mile from possible sources was detected at only 2 stations. The nutrient level of Lake Erie is high and the lake should support large fish populations. (Auth. abst.)

3690. Johnson, James H. 1960. SURFACE CURRENTS IN LAKE MICHIGAN, 1954 AND 1955. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 338, 120 pgs.

Surface currents were investigated in central and southern Lake Michigan in 1954, and in central and northern Lake Michigan in 1955. Drift bottles, drift envelopes, and plastic tubes were released in 1954, whereas drift bottles only were used in 1955.

Currents were highly variable in both years and in all areas of Lake Michigan. The general direction of drift was from west to east; currents were predominantly north-bound along the eastern shore. No prevailing current was detected along the western shore. (Auth. abst.)

3691. Marvin, Kenneth T., Zoula P. Zein-Eldin, Billie Z. May, and Larence M. Lansford. 1960. CHEMICAL ANALYSES OF MARINE AND ESTUARINE WATERS USED BY THE GALVESTON BIOLOGICAL LABORATORY. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 349, 14 pgs.

This paper describes the chemical techniques and procedures used by the Biological Laboratory of the U. S. Bureau of Commercial Fisheries, Galveston, Texas, for analyzing samples involved in the chemical and biological survey of the marine and estuarine waters of the Gulf of Mexico and also in the many laboratory and field studies and experiments that have been made pertaining to the red tide investigation. (Auth. abst.)

3692. Gauley, Joseph E. 1960. EFFECT OF FISHWAY SLOPE ON RATE OF PASSAGE OF SALMONIDS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 350, 23 pgs.

This study on the effect of fishway slope on rate of passage of salmonids was made by comparing passage time of fish in two fishways with different slopes. It is based mainly on steelhead (*Salmo gairdneri*) but includes some chinook (*Oncorhynchus tshawytscha*) and silver (*Oncorhynchus kisutch*) salmon. Both fishways were pool-and-overfall type in which 6 feet of elevation was gained. Passage of steelhead in the 1:8-slope fishway was in general, as fast as or faster than in the 1:16-slope fishway. In the 1:8-slope fishway, the passage time appeared to increase with an increase in rise between pools. In the 1:16-slope fishway, the passage time of steelhead increased as the season progressed. (Auth. abst.)

3693. Nichols, Paul R., and Marlin E. Tagatz. 1960. CREEL CENSUS CONNECTICUT RIVER SHAD SPORT FISHERY, 1957-58, AND ESTIMATE OF CATCH, 1941-56. U. S. Fish and Wildlife Service

Special Scientific Report--Fisheries No. 351, 12 pgs.

Creel census surveys were conducted by the Bureau of Commercial Fisheries on the Connecticut River shad sport fishery during 1957 and 1958. In 1957 it was estimated that 34,310 shad were caught and kept in 19,901 fisherman days, and in 1958 an estimated 38,570 shad were caught and kept in 20,242 fisherman days. In 1958 the catch increased 12.4 percent, and the effort increased 14.1 percent over that in 1957. The average catch per fisherman day (1.7 shad) was identical for both years. The estimated sport catch for each year, 1941 through 1956, was determined by ratio estimate between catch at a state-controlled area and total catch for years 1957 and 1958. (Auth. abst.)

3694. Tyler, Richard W. 1960. USE OF DYNAMITE TO RECOVER TAGGED SALMON. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 353, 9 pgs.

Experiments were conducted in July 1959, on the Kvichak River at Igiugik, Alaska, to determine the effect on adult salmon of an underwater explosion of dynamite and to determine whether dynamite could be used to recover tagged salmon from large rivers.

The experiments show that dynamite is an effective means of killing salmon and that the direction and lethal range of the blast can be controlled by varying the charge strength and water depth, and by the use of deflectors.

Techniques for the use of dynamite in tag recovery work were devised and put into use at the Kvichak counting sites where they proved successful in the recovery of four tags. (Auth. abst.)

3695. Thompson, Richard B. 1960. CAPTURING TAGGED RED SALMON WITH PULSED DIRECT CURRENT. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 355, 10 pgs.

The equipment, installation, and techniques of operation of an experiment to collect individual fish from schools of migrating adult red salmon (*Oncorhynchus nerka*) in Alaska with pulsating direct current are described. Electrodes were installed in the river in the path of the salmon. Current was turned on as the selected fish passed between the electrodes. Fish between the electrodes were forced to move towards the positive electrode, placed in slack water 3 feet deep close to shore. As they encountered the denser electrical current, the fish were electronarcotized and final capture was made with a long-handled dip net. Trial collections resulted in capturing 83 percent of the individual fish for which attempts were made. Tests to determine optimum pulse frequencies and duty cycles indicated that frequencies between 60 and 140 per second and duty cycles between 40 percent and 85 percent gave good results. A pulse rate of 90 per second at 80-85 percent duty cycle gave the best general results. (Auth. abst.)

3696. Snieszko, S. F. 1960. MICROHEMATO-

CRIT AS A TOOL IN FISHERY RESEARCH AND MANAGEMENT. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 341, 15 pgs.

The micro method of hematocrit is rapidly replacing red cell counts in clinical hematology. Observations were made on the value of this method in routine hematological examination of trouts. Under the conditions of data collection, the normal hematocrit values for brook trout were 45 to 50, for brown trout 39 to 44, and for rainbow trout 45 to 53. There was a close correlation between the hematocrits, red cell counts and hemoglobin. The commercial heparinized capillaries, while excellent for human blood, tend to give somewhat higher readings (7 to 18 percent) with trout, due to incomplete prevention of blood coagulation. The procedure as applied to trout is described in detail.

3697. Reintjes, John W., and Charles M. Roithmayr. 1960. SURVEY OF THE OCEAN FISHERIES OFF DELAWARE BAY--SUPPLEMENTAL REPORT, 1954-57. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 347, 18 pgs.

This is a final, supplemental report of a survey of the ocean fisheries off Delaware Bay, including the coastal waters lying between Barnegat, New Jersey and Chincoteague, Virginia, for the period 1954-57. Because of their seasonal nature, data pertaining to the winter fisheries (offshore otter trawl, trawl line, and gill net) were included from July 1953 through May 1958.

Measurements of catch, catch per unit effort, and total fishing effort for the major fisheries of the area (excluding the menhaden purse-seine fishery) indicate that the otter-trawl and pot fisheries have remained relatively stable during the period. The surf-clam fishery has shown an increased production, but a decline in apparent abundance. Minor fisheries, including pound net, gill net, trawl line, hand line, and purse seine for food fish, have dwindled in importance, and some are near extinction.

Recommendations concerning utilization of the fishery resources of the area and proposed studies, should waste disposal in the coastal waters be contemplated, are included. (Auth. abst.)

3698. Burrows, Roger E. 1960. HOLDING PONDS FOR ADULT SALMON. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 357, 13 pgs.

Holding ponds have been developed for the retention of the Pacific salmon (*Oncorhynchus*) during the interval between the upstream and spawning migrations. This pond type, operated either singly or in series, is a long, narrow channel with a diffused water intake and sloping banks to minimize self-inflicted injuries during the holding period. An average current velocity of 0.2 fps is maintained through the pond when water temperatures exceed 60°F. to reduce the incidence of disease. Both upstream and downstream trapping facilities are installed in the holding ponds to capture the sexually mature adults for artificial propagation. The characteristic reactions of the con-

fined salmon are described. Design drawings of the holding ponds and trapping facilities are included. (Auth. abst.)

3699. Hoffman, Glenn L. 1960. SYNOPSIS OF STRIGEOIDEA (TREMATODA) OF FISHES AND THEIR LIFE CYCLES. U. S. Fish and Wildlife Service Fishery Bulletin 175, Vol. 60, pp. 439-469.

This report is an aid to the identification of the strigeoid metacercaria found in the fishes of the world. It includes a condensed record of the known life cycles of those strigeoids that have fish as their second intermediate host. The parasites are placed in four metacercarial groups of strigeoids (Tetracotyle, Diplostomulum, Neascus, and Prohemistomulum), rather than grouped in the usual taxonomic fashion. The synopsis is world-wide, although keys are given only for the species of Tetracotyle, Diplostomulum, and Neascus of North America. Representatives of the different genera are figured and drawings are included of all available illustrations of strigeoid metacercariae of fishes. (Auth. abst.)

3700. Koo, Ted S. Y., and Howard D. Smith. 1960. MAIN-STEM AND TRIBUTARY SAMPLING OF RED SALMON SCALES FOR POPULATION STUDIES. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 362, 10 pgs.

Comparison of freshwater age composition by scale studies was made on red salmon sampled at two locations: (1) in the Kvichak River before fish dispersed into the lake system, and (2) on spawning grounds after fish had spawned. Kvichak River samples in 1956 and 1957 had higher percentages of 1-winter-in-lake fish than did spawning ground samples. The discrepancy was believed to be due to difficulties in obtaining representative samples and proper weighting from spawning grounds. The 1958 samples from both locations were comparable, probably as a mere coincidence.

It is concluded that although spawning ground sampling is essential to studies of population density, distribution, and subpopulations in a lake system, it is difficult, if not impossible, to obtain and weight the samples so that they are representative of the whole escapement. The proper place to sample the entire escapement is in a trunk river, such as the Kvichak River in the Kvichak system. (Auth. abst.)

3701. Johnson, James H. 1960. SONIC TRACKING OF ADULT SALMON AT BONNEVILLE DAM, 1957. U. S. Fish and Wildlife Service Fishery Bulletin 176, Vol. 60, pp. 471-485.

Adult salmon bearing miniature sonic transmitters were tracked individually in the forebay of Bonneville Dam. Fish were tracked as far as 10 miles upstream and for periods ranging up to 16 3/4 hours. In the release area adjacent to the dam, the fish seldom swam more than 50 feet away from shore or remained away from it for more than 2 minutes at a time. After leaving the dam most fish followed the shoreline near which they were released; they rarely swam in water more than 30

feet deep. During daylight the average speed at which they traveled over the bottom was 1.5 miles per hour, and their net rate of movement upstream was 1.2 miles per hour. Each of the three fish tracked from daylight into darkness slowed its pace or ceased swimming as darkness deepened. (Auth. abst.)

3702. Walburg, Charles H. 1960. ABUNDANCE AND LIFE HISTORY OF SHAD, ST. JOHNS RIVER, FLORIDA. U. S. Fish and Wildlife Service Fishery Bulletin 177, Vol. 60, pp. 487-501.

A method of determining the size and spawning escapement of the shad (*Alosa sapidissima*) population of the St. Johns River, Florida, is presented and population parameters are given for each year 1953 to 1958. Scientific management of the shad population in this river to obtain optimum yields is not possible at this time because factors affecting the size of run are unknown. When data on population size have been obtained for an additional number of years, studies can proceed to determine factors affecting abundance.

Examination of 3, 129 scale samples revealed that the majority of shad caught in the St. Johns River are 4 years of age. From the absence of spawning marks on the scales and from other evidence it is apparent that the shad die after their initial spawning run. Females produce 277, 000 to 659, 000 eggs, and a direct relation exists between the number of eggs produced and the age, length, and weight of the fish. The spawning season extends from late February to mid-April, during which time water temperatures range from 60° to 75°F. (Auth. abst.)

3703. Hartman, Wilbur L., and Charles Y. Conkle. 1960. FECUNDITY OF RED SALMON AT BROOKS AND KARLUK LAKES, ALASKA. U. S. Fish and Wildlife Service Fishery Bulletin 180, Vol. 61, pp. 53-60.

The relation between mid-eye-fork length and number of eggs for red salmon at Brooks Lake (1957-58) and Karluk Lake (1958) is established. A review of available literature on fecundity at Karluk Lake indicates that there may have been a long-term decrease in the size of females and correspondingly in the average number of eggs per female.

Annual variations in age composition by life-history categories and in sex ratios affect the number of eggs available for deposition. Analyses of Karluk Lake red salmon stocks show a relation between the ocean age and size of fish and their fecundity, those fish of a greater length of ocean residence and size having the largest number of eggs. Since a distinctive seasonal pattern in the occurrence of life-history categories and related sex ratios exists, it is theorized that the commercial fishery could be so concentrated as to deplete that portion of the run of highest egg production potential. (Auth. abst.)

3704. Robert, Adrien. 1960. FEEDING BEHAVIOR OF SPECKLED TROUT RAISED IN A HATCHERY AND RELEASED AS ADULTS IN A RIVER. (COM-

PORTEMENT ALIMENTAIRE DE TRUITES MOUCHETTES (*SALVELINUS FONTINALIS*) ELEVEES EN PISCICULTURE ET ENSEMENCEES EN RIVIERE A L'AGE ADULTE.) *Naturaliste Canadien* 87(4): 113-116; *Biological Abstracts*, Vol. 35, No. 17, Abst. No. 46661. 1960.

Forty-eight hours are required for food to pass through the trout's gut (24 in stomach, 24 in small intestine). In June-August insect naiads and adults form chief food. Since introduced fish showed far fewer organisms in their guts than native fish, it is concluded that they acclimate very slowly. Younger fishes adapt quicker; older fishes utilize fat reserves. (G. R. B.)

3705. Ambuhl, Heinz. 1959. THE SIGNIFICANCE OF THE CURRENT AS AN ECOLOGICAL FACTOR. (DIE BEDEUTUNG DER STROMUNG ALS OKOLOGISCHER FAKTOR.) *Schweiz. Zeitschr. Hydrol.* 21(2): 133-264; *Biological Abstracts*, Vol. 35, No. 17, Abst. No. 46721. 1960.

An optical method is described whereby current velocities at various depths in flowing water can be determined in the laboratory with accuracy. The method involves the suspension of pulverized acetylcellulose in the water and photographic recording of the movements of the particles by use of an intense light flickering 100 times per second. The particles of acetylcellulose appear on the positive prints as spots of light, the distance between spots being the distance travelled by the particle in 1/100 second. Even in currents of greatest velocity the speed is much reduced in a layer above the substratum a few millimeters thick. This offers considerable protection for animals. Current patterns and turbulence characteristics are described for artificial channels containing various obstructions. In such channels there are numerous areas where the current velocities are relatively dead. Similar dead areas occur in natural streams, and these are occupied by special faunas. Within a small area of a river or stream, even though the water is chemically homogeneous, the fauna is unevenly distributed. This was ascertained by detailed field observations. There are many small zoocoenoses which, although the same species occur in all, differ from one another quantitatively and in the proportions of the individual species. Usually they do not differ qualitatively. A number of species were tested in aquaria with known current velocities to determine the preferred velocity for each form. Some avoided swift currents, whereas others sought them. Some species were indifferent. A number of species were tested which depend upon the current for respiration. These die quickly when placed in stagnant water, even though its O_2 content may be rather high. On the other hand, they obtain adequate O_2 from flowing water in which the O_2 is very low. The behavior of rheophilous animals is not only a taxis, but also is caused by anatomical features and physiological requirements. Animals that seek and require currents are called rheostenous. Rheosteny is described as the highest degree of adaptation to flowing water. (C. C. D.)

3706. Jonasson, Petur, and Hans Mathiesen. 1959. MEASUREMENTS OF PRIMARY PRODUCTION IN TWO DANISH EUTROPHIC LAKES, ESROM SØ AND FURESØ. *Oikos* 10(2): 137-167; *Biological Abstracts*, Vol. 35, No. 17, Abst. No. 46723. 1960.

Primary production was studied in Esrom SØ and FuresØ by Steeman Nielsen's C^{14} technique. In Esrom SØ and FuresØ by Steeman Nielsen's C^{14} technique. In Esrom SØ monthly or bimonthly studies were undertaken in 1955, 1956, 1957 and 1958 at 5 stations (mostly, however, at one of the stations). Seasonal changes in production are described. Average annual gross production is estimated to be 180 g C/m^2 , which corresponds to about 450 g organic matter/ m^2 . Net production is estimated to be 75 per cent of these values, or 135 g C/m^2 and 340 g organic matter/ m^2 . Studies in FuresØ were confined to 1956. The results are compared with those obtained for the period 1953-1954 by Steeman Nielsen using C^{14} technique, and for 1950-1951 by Nygaard using the O_2 production method. Comparisons also are made between Esrom SØ and FuresØ. There was much more variation in production at different stations in FuresØ than in Esrom SØ. The annual production of FuresØ was estimated to be 225 g C/m^2 , a value that compares closely with the results reported both by Nygaard and by Steeman Nielsen. (C. C. D.)

3707. Lloyd, R. 1960. THE TOXICITY OF ZINC SULPHATE TO RAINBOW TROUT. *Ann. Appl. Biol.* 48(1): 84-94; *Biological Abstracts*, Vol. 35, No. 17, Abst. No. 46741. 1960.

Zinc sulfate was less toxic to *Salmo gairdneri* in hard water than in soft water. When the log concentration of zinc was plotted against log. median period of survival of the fish the dose response curve was linear in a very soft water, and curvilinear in a hard water, approaching an apparent threshold concentration. Solutions of zinc sulfate containing calcium chloride were less toxic than those containing an equivalent concentration of calcium as bicarbonate. An increase in temperature decreased the survival time of rainbow trout in solutions of zinc sulfate in a hard water, but the threshold concentration was not appreciably affected by changes in temperature. A reduction in the dissolved oxygen concentration of the water increased the toxicity of zinc sulfate, but the effect was reduced when the fish were previously acclimatized to the lower oxygen concentration of the test. The cause of death of fish in solutions of zinc sulfate was not by the precipitation of mucus on the gills but probably by damage to the gill epithelium. (Auth.)

3708. Poczopko, P., and A. Słonowski. 1958. A CONTRIBUTION TO THE FISHERY-BIOLOGICAL CHARACTERISTIC OF THE LOWER VISTULA. (PRZYCZYNEK DO CHARAKTERYSTYKI BIOLOGICZNO-RYBACKIEJ DOLNEGO BIEGU WISŁY. *Zeszyty Nauk. Univ. M. K. Torun. Biol.* 3:3-36; *Biological Abstracts*, Vol. 35, No. 17, Abst. No. 46752. 1960.

An analysis of the fishery catches during the years 1954-1956 was conducted on 228 km of the lower Vistula. Among non-migratory species the most

important commercially is Abramis brama, Blicca bjorkna and Rutilus rutilus are probably equally numerous in the river. The catches of migratory species show considerable yearly fluctuation. Most specimens of Salmo trutta and Vimba vimba are caught at the mouth of the river. The number of lampreys has diminished considerably in recent years. (H.S.)

3709. Disler, N. N. 1957. DEVELOPMENT OF THE AUTUMN KETA IN THE AMUR RIVER, ONCORHYNCHUS KETA (WALB). Tr. Inst. Morfol. Zhivot. Akad. Nauk SSSR 1957(20):3-70; Biological Abstracts, Vol. 35, No. 17, Abst. No. 47943. 1960.

Keta development was compared in natural conditions and in the nurseries of the Teplov Fish Station in October 1951. In nature, embryos lie separately between pebbles. A fat globule is located in the forward section of the yolk sac. The young switch to external feeding as soon as the prehensile function of the mouth is developed and the penetrability and peristalsis of the intestine appears, even before the air bladder is filled. Food is found by means of the tactile and taste organs since sight is not developed. The larvae subsequently accumulate fat which accommodates the insufficient food of the reservoir. In the nurseries the embryos lie on the level bottom and are churned into heaps. They orient with the head down. A vitelline drop is displaced in the rear section of the sac and presses into the intestine preventing the passage of food. Such larvae transfer to external feeding only after the air bladder and the stomach are filled with air. The young are born and object vision is prematurely developed in them, by means of which they search for food. The larvae begin to swim early, having still weakly-developed fins and a large yolk sac. Toward the end of the larval period the fat in them is almost 4 times less than in those developed in natural conditions. The author considers the exit of the young into the river before resorption of the yolk is inadmissible.

3710. Angelescu, Victor, Francisco S. Gneri, and Alberto Nani. 1958. THE HAKE OF THE ARGENTINE SEA. BIOLOGY AND TAXONOMY. (LA MERLUZA DEL MAR ARGENTINO. BIOLOGIA Y TAXONOMIA.) Servicio de Hidrografia Naval, Secretaria de Marina: Buenos Aires, Argentina, 224 pgs; Biological Abstracts, Vol. 35, No. 17, Abst. No. 49257. 1960.

The hake fished off the coast of Argentina is considered to be Merluccius m. hubbsi. Males mature at the end of their second year and the oldest taken were age 6 and had attained a length of 68 cm. Females spawn first at age 3-4, survive to age 9 and reached an extreme length of 95 cm in the samples taken. Spawning takes place in Dec. - Feb. with the extreme limits of the period being Nov. - March. The population moves deeper in winter and shallower in summer but remains throughout in water with a temperature of 5-8°C. The hake feeds on fish, pelagic crustaceans and cephalopods with the larger hake being the more

piscivorous. The food chain is discussed. The various other species of fish that are captured with the hake are listed. The taxonomic history, affinities and geographic distribution of the various species of Merluccius are discussed. (F.E.J.F.)

3711. Cassie, R. Morrison. 1959. SOME CORRELATIONS IN REPLICATE PLANKTON SAMPLES. New Zealand Jour. Sci. 2(4): 473-484; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43613. 1960.

Two plankton samples were taken with a centrifugal pump from the dock wharf, Wellington, on 23 March and 5 April 1956. Each sample consisted of 50 subsamples of 200 litres volume from a depth of 1 metre. Tidal movement was such that the effective distance between subsamples was approximately 5 to 10 metres. Numerical correlations between species counts, and autocorrelations within species were examined and subjected to multiple regression analysis. A marked difference in the pattern of distribution was found between the two samples. In sample 1 variance was low, dispersion was similar for all species, inter-specific correlation was low, and autocorrelation was absent. In sample 2 variance was higher, dispersion was heterogeneous, and autocorrelation was present. Only one pair of species, Temora turbinata and Acartia clausii, was correlated in both samples. Correlation between species may be due to direct biological attraction or to a common reaction to external factors. The second explanation seems preferable and further investigation of the influence of physical factors is desirable. Departure from randomness in distribution can be partly or wholly accounted for in some species by regression on other species, but the casual factors are as yet unknown. The pattern of newly laid teleostean eggs is consistent with a simple process of random diffusion from a central point of deposition. (Auth. summ.)

3712. Cassie, R. Morrison. 1960. FACTORS INFLUENCING THE DISTRIBUTION PATTERN OF PLANKTON IN THE MIXING ZONE BETWEEN OCEANIC AND HARBOUR WATERS. New Zealand Jour. Sci. 3(1): 26-50; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43614. 1960.

Using a pumping technique, previously described, 60 plankton samples were taken in a continuous series at a depth of 5 metres. The line of samples covered a distance of about 4 miles, running from Cook Strait up the main entrance channel of Port Nicholson. Temperature and salinity were recorded simultaneously from the same depth. The water traversed is divided into three zones: 1. Cook Strait; 2. intermediate mixing zone; 3. harbour water. Six dominant species of plankton were counted in the samples. For each zone, multiple regression equations are computed, relating numerical abundance of each species to that of the remaining 5 species, and to temperature, and salinity. The partial regressions of Oithona similis, Elminius modestus nauplii, Polydora polybranchiata larvae, and Coscinodiscus wailesii, were positive on temperature, but negative on salinity. The partial regression of Paracalanus parvus was negative on temperature, positive on salinity. It is possible that the combina-

tion of two opposite-sign regressions may be induced by density effects. Both Paracalanus and Elminius showed the same relationship to temperature and salinity as in a previous experiment. Oithona and Elminius both showed positive partial correlation to Paracalanus but not to each other. Neither of these correlations agrees with previous experiments and it is possible that other variates, as yet unknown, are involved in the relationship. Negative partial correlations between species do not reach significance but special attention has been paid to such relationships owing to their apparent rarity. It is possible that Coscinodiscus is inversely related to both Paracalanus and Melosira granulata. Otherwise Melosira is entirely independent of both other species and physical variates. The results of this and previous experiments are discussed. Factors influencing spatial distribution of plankton species may be divided into four categories: (1) random variation; (2) variable physical properties of the water; (3) other pelagic species; (4) internal behavior patterns between individuals of the same species. (Auth. summ.)

3713. Hogan, D. J., and L. Wilkinson. 1959. A SURVEY OF POLLUTION IN THE AVON AND HEATHCOTE RIVERS, CHRISTCHURCH, NEW ZEALAND. *New Zealand Jour. Sci.* 2(4): 506-530; *Biological Abstracts*, Vol. 35, No. 16, Abst. No. 43623. 1960.

The topography and physical characteristics of the rivers and sources of pollution are described in some detail. Fortnightly samples from points in the tributaries, along the lengths of the rivers, and in their estuary taken at low water over a period of one year were examined chemically and bacteriologically. Average values for the year and four seasons are presented in the form of "profile" graphs which illustrate the changes in river conditions from head-waters to estuary. The discussion elaborates the more significant results and compares the effect of season, tide, and different river usage on the pollution and hydrography of the two rivers. (Auth. summ.)

3714. Prat, Silvestr, and Zdenek Sestak. 1959. AUTOTROPH-HETEROTROPH RELATIONSHIPS IN NATURAL WATERS. *Biol. Plant. (Praha)* 1(2): 81-92; *Biological Abstracts*, Vol. 35, No. 16, Abst. No. 43624. 1960.

In evaluating the purity and trophism of water, biological tests must be supplemented by chemical ones. When autotroph and heterotroph organisms present in water are counted it is recommended to compare the content of chlorophyll with the amount of "organic carbon". Methods of determination of these magnitudes were tested on pure cultures of green algae. A standard method of chlorophyll determination and permanganate and bichromate oxidation for "organic carbon" determination are proposed. (Z.S.)

3715. Sterba, O. 1959. A FAUNISTIC-SAPROBIOLOGICAL STUDY ON THE UPPER

COURSE OF THE OSLAVA RIVER. (FAUNISTICKO-SAPROBIOLOGICKA STUDIE O HORNÍ CASTI REKY OSLAVY VZHLEDEM K VYSTAVBE NADRŽE U NOSTISTE. *Zool. Listy* 22(4): 329-356; *Biological Abstracts*, Vol. 35, No. 16, Abst. No. 43625. 1960

The portion of the Oslava above the community of Modiste near Velke Mezirci was investigated with special consideration of the proposed dam for the water-distributing system. A biological method, faunistic analysis of the bottom of the river bed, was employed. The saprobia have been evaluated by means of the so-called "saprobial number". Methods for its calculation are presented. It is a rather exact indication of saprobia impurities and does away with subjective elements which have previously influenced evaluation of the saprobia. The area of the stream was studied from November 1955 to December 1956. The winter visits were especially productive, since at this time important conditions could be verified which affected purity of the river water. All of the material was collected in river rapids and currents at 14 permanent cross-sections of the river and its tributaries. In the highest cross-section (I) above the community of Samozin the purity of the river lies at the boundary between α oligosaprobia and β mesosaprobia. In its further course the river becomes impure by the communities of Obyctov, Ostrov n. O., Radostin, and especially by the starch factory in Hodiskov. At the last cross-section (XIV), where the river will empty into the reservoir of the dam, saprobia approach those of the I. cross-section. This may be traced back to the capacity of the river for self-purification. The entire portion of the river which was investigated shows a quantity of phytoplankton which was carried away from ponds. Measures are suggested to increase the purity of water in the river and in the future dam. It is expected, however, that the so-called "water-flowers" will form in the dam, at least to a small extent. The saprobiological analysis is based on the determination of approximately 8,500 organisms (162 different species or groups of animals). The principal groups were: Trichoptera (31 species) and Ephemeroptera (27 species). Most numerous represented were Ephemeroptera with 5061 specimens and Simuliidae with 960 specimens. The following are new for Moravia: larvae of Baetis niger, Centroptilum penullatum (Ephemeroptera), Ithytricha lamellaris, Hydroptila sp. - sparsafemoralis (Trichoptera) and Isoperla difformis (Plecoptera). The author deals in detail with organisms which occur regularly and in larger quantities, considers their requirements for purity of the water, their occurrence during the course of the year, and investigates the possibility of using them as indicators of impurity of the water. (MDS)

3716. Bunag, D. M. 1958. "BANGOS" (CHANOS CHANOS) FRY TRAWL. *Indo-Pacific Fish. Council. Proc.* 7(2/3): 77-81; *Biological Abstracts*, Vol. 35, No. 16, Abst. No. 43630. 1960.

An appraisal of the predominant method of catching milkfish fry is given. The author describes the construction and operation of gear which increase the

rate of catch, permit more rapid and easier operation, are economical and can be operated in shallow as well as in deep water. (MDS)

3717. Hayashi, S. 1958. A REVIEW ON AGE DETERMINATION OF THE PACIFIC TUNAS. Indo-Pacific Fish Counc. Proc. 7(2/3): 53-64; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43636. 1960.

Previous works on the growth and age of 5 species of the Pacific tunas are reviewed. Estimated growth curves of each species are found to differ. Problems inherent in age determination of the tunas are discussed on the basis of studies on the spawning behaviour of the species and on the growth of other fishes, for which methods of age determination have been established. (MDS)

3718. Matida, Y., S. Kimura, and M. Tamakawa. 1958. A PRELIMINARY EXPERIMENT OF AGRICULTURAL INSECTICIDES AND PADDY-CUM-FISH CULTURE. Indo-Pacific Fish. Counc. Proc. 7(2/3): 173-181; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43650. 1960.

Diazinon, Dipterex, Folidol, DDVP, Dieldrin and Endrin, all commonly used agricultural insecticides, were tested to determine their toxic effect on carp and other aquatic animals in rice fields. Laboratory bioassay studies were also performed to determine the toxicity of each chemical. Diazinon, Dipterex, Folidol and DDVP were found to be non-toxic to fish while Dieldrin and Endrin were found to be detrimental. (MDS)

3719. Mitra, G. N. 1958. PISCICULTURE IN RECLAIMED SWAMPS AND ITS ROLE IN RURAL ECONOMY IN ORISSA. Indo-Pacific Fish. Counc. Proc. 7(2/3): 183-185; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43652. 1960.

A new technique to reclaim deeply silted swamps at low cost is described. Such reclaimed swamps have been successfully used for agriculture or for pisciculture. It is concluded that the increased production from reclaimed swamps would add considerably to the rural income, provide employment to a number of persons and reduce malaria in addition to contributing to the general sanitation of the area. (MDS)

3720. Otsu, T., and R. N. Uchida. 1958. AGE DETERMINATION OF ALBACORE BY THE VERTEBRAL METHOD. Indo-Pacific Fish. Counc. Proc. 7(2/3): 49-52; Biological Abstracts, Vol. 35, No. 16, Abst. No. 43653. 1960.

An attempt was made to determine the age of central North Pacific and Hawaiian albacore, *Germo alalunga* by counting rings in the vertebral centra. Because repetitive results of the same or different operators could not be duplicated, it is concluded that this method is not satisfactory for age determination of albacore from these areas. (MDS)

3721. Hoffert, Jack R., and P. O. Fromm. 1959.

ESTIMATION OF THYROID SECRETION RATE OF RAINBOW TROUT USING RADIOACTIVE IODINE. Jour. Cell and Comp. Physiol. 54(2): 163-169; Biological Abstracts, Vol. 35, No. 16, Abst. No. 44260. 1960.

Thyroid secretion rates of *Salmo gairdnerii* were determined using a technique which has been successfully applied to homoiothermic animals. The secretion rate of trout was found to be some 10 to 19 times below values for homoiothermic animals. No significant difference in the thyroid secretion rate of 1 and 2 year-old fish maintained at 13°C was found. One-year-old fish acclimated to 3°C had thyroid secretion rates significantly lower than those of fish of both age groups kept at 13°C. The need for making body background corrections in studies of output of radioiodine from the thyroid of fish is discussed. It is concluded that the thyroid of rainbow trout has little or no influence on the oxidative metabolism at low temperature and it appears doubtful that the trout thyroid is involved in a temperature compensating mechanism as has been previously postulated. (Auth. concl.)

3722. Dratchev, S. M., L. E. Korsh, and O. V. Mityagina. 1957. ON THE MICROFLORA OF THE WATER SURFACES. Jour. Hyg., Epidemiol., Microbiol. and Immunol. (Czechoslovakia) 1(4): 431-440; Biological Abstracts, Vol. 35, No. 16, Abst. No. 45431. 1960.

In an examination of the flora of the Klyazmin reservoir, near Moscow, the author found the bacteria count in the 1 mm surface film to contain 2-10 times as many saprophytic bacteria as found at deeper levels. Substances were found concentrated in the surface film, organic substances and especially nitrogenous and ether-soluble substances. The bacteria count from the surface foam was 100-1,000 times higher than that of water, e.g., *Bacterium (Escherichia) coli* 2, 270/ml. MDS.

3723. D'Ancona, Umberto. 1959. DISTRIBUTION OF THE SEXES AND ENVIRONMENTAL INFLUENCE IN THE EUROPEAN EEL. Arch. Anat. Microsc. et Morphol. Exptl. 48 bis: 61-71; Biological Abstracts, Vol. 35, No. 16, Abst. No. 46186. 1960.

Only silver eels were used in this study since it is always possible to identify sex at this stage. In general females migrate further up rivers, males tend thus to be more numerous in coastal waters. In the Tyrrhenian coastal lagoons females made up only 2-3% of the population, while in Adriatic lagoons they comprised 50-90% of the population. Genotypic sex determination is gradual and some external conditions may cause deviation from the genetic sex. Higher temperature and overcrowding favor male differentiation. Also injected extradiol propionate can invert the sex of the male silver eel. (H.H.)

3724. Klawe, W. L. 1958. REEXAMINATION OF JUVENILE TUNA CAUGHT OFF THE PACIFIC COAST OF MEXICO BY THE VANDERBILT EXPEDITION OF 1941. (NUEVO EXAMEN DE ATUNES

JOVENES CAPTURADOS FRENTE A LA COSTA OCCIDENTAL DE MEXICO DURANTE LA QUINTA EXPEDICION GEORGE VANDERBILT (1941.). Ciencia (Mexico) 18(11/12): 245-247; Biological Abstracts, Vol. 35, No. 16, Abst. No. 46188. 1960.

Juvenile tuna caught off Manzanillo, Sinaloa, prove to be *Neothunnus macropterus*, not *Thunnus thynnus* as previously identified. (H. M. S.)

3725. Boothroyd, E. R. 1959. CHROMOSOME STUDIES ON THREE CANADIAN POPULATIONS OF ATLANTIC SALMON, *SALMO SALAR* L. Canadian Jour. Genetics and Cytol. 1(2): 161-172; Biological Abstracts, Vol. 35, No. 13, Abst. No. 33412. 1960.

The chromosome number $2n = 56$ has been established for one spring-run and two fall-run populations of Canadian Atlantic salmon, *Salmo salar* L. Morphologically, the complement appears to be comprised of 8 pairs of V- and J-shaped and 20 pairs of rod-shaped chromosomes. Certain of these pairs can be distinguished by length, arm ratio, or secondary constructions. The karyotype of the Canadian salmon populations could be derived from that reported for European ($2n = 60$; 6 pairs of V's and J's and 24 pairs of rods) by two centric fusions. (Auth. summ.)

3726. Smith, David L. 1960. THE ABILITY OF THE TOP MINNOW, *GAMBUSIA AFFINIS* (BAIRD AND GIRARD), TO REPRODUCE AND OVERWINTER IN AN OUTDOOR POND AT WINNIPEG, MANITOBA, CANADA. Mosquito News 20(1): 55-56; Biological Abstracts, Vol. 35, No. 13, Abst. No. 33615. 1960.

Experiments have shown that the top minnow, *G. affinis*, being successfully established in a climate as severe as that which prevails here. (Auth.)

3727. Leentvaar, P. 1958. HYDROBIOLOGY AND THE CONSERVATION OF NATURE. (HYDROBIOLOGIE EN NATUURBEHOUD.) Levende Natuur 61(1): 6-12; Biological Abstracts, Vol. 35, No. 13, Abst. No. 33677. 1960.

An outline is given of the task the RIVON (State Institute for Investigations related to the Conservation of Nature) sees before it re the conservation of natural bodies of water in the Netherlands. Conservation of character, flora, and fauna of a great variety of waters situated in various parts of the Netherlands will be attempted. Detailed characterizations must precede further investigations. It is not only through pollution that waters of various description are spoiled but also through the process of eutrophication, e.g., through drainage water rich in nutrients from arable soil in the vicinity. Examples are given of natural waters of which aspect, flora, and fauna are or threaten to be changed, and often changed irreversibly, through eutrophication and pollution. (P. K.)

3728. Clark, Eugenie. 1958. JELLIED CONDITION IN *PARALICHTHYS SQUAMILENTUS* FROM THE GULF OF MEXICO. Quart. Jour. Florida Acad. Sci. 21(2): 131-144; Biological Abstracts, Vol. 35, No. 13, Abst. No. 33684. 1960.

Quantities of *P. squamilentus* caught in 62 fathoms off Appalachicola in January developed a condition where the flesh became opalescent, watery, and soft in all individuals reported. (Auth. abst.)

3729. Power, G. 1959. FIELD MEASUREMENTS OF THE BASAL OXYGEN CONSUMPTION OF ATLANTIC SALMON PARR AND SMOLTS. Arctic 12(4): 195-202; Biological Abstracts, Vol. 35, No. 13, Abst. No. 33691. 1960.

The investigation was undertaken to study, under conditions as nearly natural as possible, the basal oxygen requirements of salmon parr and smolts living at the northern limit of their range in Ungava. Temperature is undoubtedly the most important variable affecting the oxygen consumption of an organism in the natural environment and those inhabiting rivers are unable to avoid exposure to temperature fluctuations, which in Ungava often reach 3°C daily, superimposed on a seasonal cycle with a range of approx. 15°C. Water of known oxygen concentration was passed through a chamber containing the experimental fish and the overflow was collected to determine the amount of oxygen extracted and the rate of flow through the apparatus. Maximum oxygen consumption occurred at midnight and midday and minimum consumption during early morning and late afternoon. The regression equation describing the smolts is $\log y = 0.06123x + 2.1087$, where y is oxygen consumption in ml. /gm. /hr. and x is temp. in °C. The equation for parr is $\log y = 0.04360x + 2.3497$. The oxygen consumption per unit weight of smolts is lower than that of parr below 13.5°C but above that temp. it is higher. This is because the rate of increase of oxygen consumption with temperature is greater for smolts than for parr, indicating that metabolically smolts are more responsive to temperature change. (W. W. J.)

3730. Zaytsev, Yu. P. 1959. THE EFFECT OF SUNLIGHT ON PELAGIC FISH EGGS. Dopovidi Akad. Nauk URSR 1959(8): 917-920; Biological Abstracts, Vol. 35, No. 17, Abst. No. 33694. 1960.

The author conducted experiments; the equipment used excluded the possibility of overheating of the water, a change in the conditions of the gas and pH in the vessels containing eggs, subjected to a direct lighting by the sun. Direct sunlight does not cause notable changes of the eggs during development. The same can be said for development in semi-dark conditions.

3731. Swarup, H. 1959. THE OXYGEN CONSUMPTION OF DIPLOID AND TRIPLOID *GASTEROSTEUS ACULEATUS* (L.). Jour. Genetics 56(2): 156-160; Biological Abstracts, Vol. 35, No. 13, Abst. No. 34390. 1960.

Triploid *G. aculeatus* fish consumed less O_2 than did diploids, as determined by Winkler's method. The respiration rate of triploids was significantly lower than that of diploids if calculated on body surface, but it was not if calculated on body weight. (G. W. B.)

3732. Ashby, Kenneth R. 1959. THE EFFECT OF

A LOW CONCENTRATION OF ESTRADIOL AND TESTOSTERONE ON GONADAL DIFFERENTIATION OF *SALMO TRUTTA* L. (L'EFFETTO DI BASSE CONCENTRAZIONI DI ESTRADIOLO E DI TESTOSTERONE SUL DIFFERENZIAMENTO GONADICO DI *SALMO TRUTTA* L.) Riv. Biol. (Perugia) 51(4): 453-467; Biological Abstracts, Vol. 35, No. 13, Abst. No. 34449. 1960.

Females of *Salmo trutta* reared at about 13°C from ova obtained from Recoaro (Veneto) had an intersexual phase during sexual differentiation unlike those previously reared at 8°C from ova obtained in Northern England. Both estradiol and testosterone, at a concentration in the culture medium averaging 5µg/l, induced in genetic females hypertrophy and ciliation of that part of the somatopleure which becomes in most teleosts included in the epithelium lining the oviducts, and in genetic males a less marked quickening of the development of the vasa deferentia. Both hormones prolonged the intersexual phase in the ovaries, testosterone probably having the stronger effect, but there was little effect on the testes possibly because the germinal elements were still in the period of stasis at the time of the experiments. Alcohol administered to a control culture at a concentration of 0.5 cc/l for about half of each day had little or no effect on the course of development. (Auth. summ.)

3733. Kirshenblat, Ya. D. 1959. THE ACTION OF CORTISONE ON THE OVARIES OF THE LOACH. Biul. Eksperim. Biol. i Med. 47(4): 503-507; Biological Abstracts, Vol. 35, No. 13, Abst. No. 34462. 1960.

Injection of cortisone to loaches (*Misgurnus fossilis*) caused mutation of oocytes without ovulation. The same could be observed in in vitro experiments. With the administration of cortisone and subliminal doses of purified luteinizing hormone the ovulation and oviposition of mature ova occurred 12 to 18 hr. earlier than in the instances of large doses of luteinizing hormone without cortisone. Evidently a certain glucocorticoid, similar to cortisone, takes part in the physiological mechanism causing the fish to change into conditions of spawning. It acts directly on the ovaries and is a synergist of the luteinizing hormone. (Auth. summ.)

3734. Ivanov, M. V., and L. S. Terebkova. 1959. MICROBIOLOGICAL PROCESSES OF HYDROGEN SULFIDE FORMATION IN LAKE SOLENOE II. Mikrobiologiya 28(3): 387-391; Biological Abstracts, Vol. 35, No. 13, Abst. No. 35556. 1960.

Putrefactive bacteria of the Solenoe Lake do not play any significant role in the formation of H₂S since as a rule their number is small both in water and in bottom deposits. A rise in the number of these bacteria is recorded only for a short period of time, viz., upon extinction of phytoplankton. The main bulk of H₂S of the lake is due to the activity of sulfate reducing bacteria which are widely spread in the muds and are as numerous as 1000-10,000 cells per liter of crude mud. The rate of H₂S production as due to microbiological reduction of sul-

fates in the deep part of the lake amounts to 0.9-3.2 mg H₂S per liter mud a day. In shallow waters this figure is still higher amounting to about 5 mg H₂S per 1 liter mud a day, and in some samples to 15-19 mg H₂S per 1 liter mud a day. During the summer period hydrogen sulfide formation in the Solenoe Lake proceeds at a higher rate than in winter. (Auth. summ.)

3735. Rodina, A. G. 1959. CHANGE IN BACTERIAL FORMS IN FISH PONDS AS A FUNCTION OF TYPE OF FERTILIZERS. Mikrobiologiya (Transl.) 28(3): 392-398; Biological Abstracts, Vol. 35, No. 13, Abst. No. 35559. 1960.

Submerged slides kept during the vegetation periods (from June to September) in 2 fish-ponds of the Latvian SSR have revealed a change in the composition of the bacterial flora and growth density as caused by the fertilizers. In this way a confirmation has been obtained of the regularities underlying the population dynamics of bacterioplankton previously obtained by direct count. The control pond was least abundant in bacteria during the 2 summer periods studied. The fertilizers (both mineral and organic) increased the bacterial number in the ponds, the density of slide growth and diversity of the attached forms. Combined mineral fertilizers (nitrogen, phosphorus, potassium and calcium) increased the growth density on the slides and the diversity of the bacterial flora as compared with ponds fertilized with phosphorus-potassium or with nitrogen-potassium. Still more abundant was microflora in ponds with complex fertilizers, particularly within the zones of plant fertilizers. Decomposition of the vegetation mass introduced into the ponds was accompanied with a change in the bacterial composition and in their number both total and of individual species. The development of the mineralization processes greatly increased the number of attached cells. Individual species have become enormously numerous. With the exhaustion of nutrient compounds in water the species composition of microflora became less variegated and the number of cells of each species decreased. The representatives of all microbe groups tested have attached themselves to the slides, such as putrefactive microbes, phosphorus (both groups), cellulose decomposing, *Azotobacter*, yeasts, imperfect fungi. The method of embedding the slides rendered it possible to follow up the dynamics of individual groups in the course of utilization of the fertilizers tested. (Auth. summ.)

3736. Chashchin, M. A. 1957. DYNAMICS OF THE PARASITIC FAUNA IN THE PIKE IN RELATION TO THE SEASON AND TYPE OF RESERVOIR IN VYATKA RIVER BASIN. Tr. Kirgis. S. kh. Inst. 12(24): 175-180; Biological Abstracts, Vol. 35, No. 13, Abst. No. 36310. 1960.

A study has been made of the parasitic fauna in the pike during all seasons of the year, in reservoirs of both circulating and semicirculating types in 1938-1950. Four species of mucous Sporozoa were found, 1 species each of monogenetic trematodes, cestodes, leeches, crustaceans and mollusks, 4 digenetic trematodes, 3 Acanthocephala and 4 species of nematodes.

The rate of infection in older pike is higher than in the river pike, which is explained by the low circulation of the reservoirs. The infection of pike by the basic species of parasites increases during spring months; this is connected with the increase of the intermediary hosts of a great many pike parasites. Fish flatworm proceroids (*Diphyllobothrium latum*) have not been detected in the basin.

3737. Bousfield, E. L., and A. H. Leim. 1959. THE FAUNA OF MINAS BASIN AND MINAS CHANNEL. Natl. Mus. Canada Bull. 166. 1-30; Biological Abstracts, Vol. 35, No. 13, Abstract No. 36341. 1960.

Minas Channel and Basin, including Cobequid Bay, at the upper end of the Bay of Fundy, form an unusual coastal marine habitat. The tidal amplitude is up to 53 ft., and because of gentle shoreline gradients, some beaches are more than 3 mi. wide at low water. During the period June 23 to August 2, 1958, some 30 stations along the shores of the region were visited. Collections of intertidal invertebrates were made at 16 stations, and hydrographical measurements at 7. More than 130 spp. of littoral marine invertebrates were obtained, of which the crustaceans and mollusks, making up 90% of the total, are treated herein. Physical characteristics of the region are described. Tabulated data are given on the hydrographic conditions. The history of the sea fisheries of the region is reviewed. The annotated faunal list includes 36 spp. of fish, 25 spp. of hydromedusae, 14 spp. of polychaetes, 68 spp. of crustaceans, 3 spp. of arachnids, 36 spp. of gastropods, 2 spp. of Amphineura, 31 spp. of pelecypods, 1 sp. of Chaetognatha, 6 spp. of Echinodermata, 1 sp. of Bryozoa, 1 sp. of Brachiopoda, and 4 spp. of Tunicata. The hydrographic and marine biological features of the area are discussed. It is mentioned that some of the spp. taken during the course of this work are new to the Canadian Atlantic coast.

3738. Buckmann, A. 1956. MARINE FISHERIES BIOLOGY AND GENERAL OCEANOGRAPHY. (MARINE FISCHEREIBIOLOGIE UND ALLGEMEINE MEERESBIOLOGIE.) Experientia 12(11): 405-411; Biological Abstracts, Vol. 35, No. 14, Abst. No. 36615. 1960.

A review of the general development of marine biological research, both fundamental and applied. When marine fishery research was instituted, there was no lead from fundamental marine ecology, as would generally be the case from fundamental research to applied. But fundamental research profited from the commercial interest in fishery science and was greatly promoted along with it. The mutual promotion of both lines of research is shown in the work of Hensen and Heincke. In modern times, one method has been found equally suitable for, and has been generally applied in, both lines of research: this is the establishment of the abundance and distribution of a single species and developmental stages in the sea on repeated cruises of research vessels, in relation to the distribution of external

conditions, such as temperature, salinity, currents, nutrients, food organisms and animal predators. Important indications concerning the influence of external conditions on populations could be derived from similar observations. At present, investigations in experimental ecology are urgently needed in order to corroborate the inferences drawn from these in situ-observations. Moreover, the progress of fishery research will to no small degree depend on increased investigations in marine animal physiology and in the microbiology of the seas. (Auth. summ.)

3739. Kawamoto, N. Y. 1956. EXPERIMENTS WITH THE FISH GATHERING LAMP. Indo-Pacific Fish. Council. Proc. 6(2/3): 278-280; Biological Abstracts, Vol. 35, No. 14, Abst. No. 36904. 1960.

A dull-black round wooden tank 100 cm in diameter and 25 cm in depth was divided radially into 8 compartments which were open to each other at the center. The tank was filled with water to 20 cm; a 10 x 14 cm color filter was placed over a light window on the upper side of each compartment with a 60 watt electric bulb set 20 cm above each filter. Luminosity was adjusted by placing white papers over the filters so that the illumination for colored lights equaled 50 lux at the surface of each compartment. Random and wave length order of color filters were used, also 60 and 100 watt bulbs, but fish attraction became irregular at the higher levels. The greatest attraction noted for *Oplegnathus* (parrot fish), *Scomberomorus* (seer fish), *Spheroides* (tiger puffer) and *Sphyræna* (barracuda) occurred in the green and blue-green range, and the product of light energy of a certain wave length and visual acuity for that light was called the spectra luminosity for that wave length. Spectral luminosity was calculated from the range of visible spectrum for the fish. The ratio of fish attraction rates for 2 lights was proportional to the ratio of the spectral luminosities of the 2 lights, and "visual efficiency" was calculated from the ratio of spectral luminosity to radiant energy. In the case of *Spheroides rubripes*, green light showed largest visual efficiency, followed by blue, and that of red light was smallest; red light with a radiant energy 22 times that of green light had a visual efficiency less than 1/62 of that of the latter. Experiments with off-shore nets were also conducted, and the effects of moonlight (0.06-0.07 lux at the surface) accounted for. *Girella punctata* and *Rudarius ercodes* were found to have marked light-approach tendencies in daytime and a loss of such activity at night. Gathering rate under bright white light was high in the daytime, lower towards evening; conversely the rate increased for dimly lit areas with increasing darkness. With these fish a rhythmicity in phototaxis for colored light was found when red and green lights were arranged at the sides of the tank through 24 hours. Green light was highly effective in daylight; red light increased in effectiveness in the evening and reached maximum effectiveness in the middle of the night and early morning hours. With the approach of sunrise the fish returned to daytime behavior. (MDS)

3740. Boschung, H. T., Jr. 1957. SOME INTERESTING RECORDS OF MARINE FISHES FROM ALABAMA. Jour. Alabama Acad. Sci. 29: 33-34; Biological Abstracts, Vol. 35, No. 14, Abst. No. 36931. 1960.

Since 1950, 168 species of fishes have been recorded from Mobile Bay and the Gulf shore of Alabama. Of these, the distribution of the following is discussed in detail: houndfish, wahoo, African pompano and violet goby. (MDS)

3741. Nelson, Gid E., Jr. 1958. THE LIMNOLOGY OF A SMALL ARTIFICIAL IMPOUNDMENT IN ALABAMA. Jour. Alabama Acad. Sci. 30(2): 39-50; Biological Abstracts, Vol. 35, No. 14, Abst. No. 36986. 1960.

Three sampling stations were established in Alabama College Lake, Shelby County, a 17-acre body with average depth 7 feet, and visited at 10-day intervals for 1 year. One period of stratification existed from April to Oct., the depth of the thermocline shifting from 2 to 8 feet. Essentially uniform chemical and physical conditions prevailed at the collecting sites with free CO₂ low and pH on the alkaline side. Oxygen deficiency was seldom found. Net phytoplankters were scarce, except for limited times at the creek inlet. Of zooplankters, only rotifers and particularly *Keratella* reached a peak of 1000 or more per liter. All plankters were scarce from Feb. to May. (J. C. O'K.)

3742. Drilhon, Andree. 1960. THE APPLICATION OF STARCH GEL ELECTROPHORESIS TO THE STUDY OF THE SERUM PROTEINS OF FISH. (L'APPORT DE L'ELECTROPHORESE EN GEL D'AMIDON A L'ETUDE DES PROTEINES SERIQUES DES POISSONS.) Bull. Inst. Oceanogr. (Monaco) 1168. 1-30; Biological Abstracts, Vol. 35, No. 14, Abst. No. 37734. 1960.

Starch gel electrophoretic method made it possible to discern a certain number of patterns in various species of fish (cyclostoms, selacii, teleosts). These results in addition to previous data allow a better understanding of the structure of serum proteins. The complexity of some of these proteins (*Petromyzon marinus*) is shown. Each species has its protein characteristics with fine special structures which are actually studied. (Auth. summ.)

3743. Mislin, H. 1959. THE CENTRAL NERVOUS SYSTEM PECTORAL FIN RHYTHM IN YOUNG TROUT (*SALMO FARIO*) IN THE YOLK SAC STAGE. FIRST EXPERIMENTAL LOCALIZATION. (UBER DIE ZENTRALNERVOSE BRUSTFLOSSENRYTHMIK DER JUNGFORELLEN (*SALMO FARIO*) WAHREND DER DOTTERSACKPERIODE. (ERSTE LOKALISIERUNGSVERSUCHES).) Rev. Suisse Zool. 66(2): 321-330; Biological Abstracts, Vol. 35, No. 14, Abst. No. 38317. 1960.

The vibration of the pectoral fins in the egg stage and 1st stage after hatching are under central control. The autorhythmical cells responsible for

this fin rhythmicity are concentrated in the medullary spinal region. When these cells are cut out, fin movements decrease, become periodic, or stop. (R. M. C.)

3744. Lewis, William M. 1959. NOTES ON THE LIFE HISTORY OF THE STEEL-COLORED SHINER, *NOTROPIS WHIPPLEI* (GIRARD). Trans. Illinois State Acad. Sci. 52(1/2): 59-64; Biological Abstracts, Vol. 35, No. 14, Abst. No. 39845. 1960.

The steel-colored shiner shows promise of being an important commercial bait species. It occurs in dense populations in pond-like environments, can be handled in warm weather and by nature is a very active minnow. The present study includes a consideration of the age composition, spawning time, rate of growth, reproductive potential, habitat in which it is found and some of its parasites. The steel-colored shiner typically attains a maximum age of 2 years. One-year-old fish spawn in late Aug. or early Sept. whereas the few 2-year-old fish spawn in July. In the population studied in the present investigation, at the end of their first year of life the fish attained standard lengths of 19 to 32 mm and at the end of their second year, 37 to 53 mm. Parasites included *Ligula intestinalis* and *Lerneae*. Number of eggs in ovaries varied from 610 to 1308. Trautman is reported to have observed the steel-colored spawning on the underside of logs. Stomach contents indicate this shiner to be primarily an insectivorous form. (W. M. L.)

3745. McAllister, D. E., and Sherman Bleakney. 1959. SOME FRESHWATER FISHES FROM NORTH-EASTERN QUEBEC AND LABRADOR. Natl. Mus. Canada Bull. 166. 31-39; Biological Abstracts, Vol. 35, No. 14, Abst. No. 39846. 1960.

Systematic and distributional notes, with collection data, on 11 spp. (7 spp. of Salmonidae, 1 of Gadidae, 2 of Gasterosteidae, 1 of Cottidae). In addition, a specimen of *Esox lucius* (northern pike) (Esocidae) is reported as seen but not collected.

3746. Stegman, Jerry L. 1959. FISHES OF KINKAID CREEK, ILLINOIS. Trans. Illinois State Acad. Sci. 52(1-2): 25-32; Biological Abstracts, Vol. 35, No. 14, Abst. No. 39847. 1960.

An annotated species list of collected fishes which gives spawning and food habit data. Physico-chemical stream characteristics and available foods are related to interspecies competition and predation among the fishes. Mention is made of sodium cyanide as a collection tool and species captured primarily by this method. Initial collection is cited for *Etheostoma spectabile* (Agassiz) in southern Illinois. The species composition of the fish population indicates bait minnows to be the primary fishery value. (J. L. S.)

3747. Kalman, Sumner M. 1959. SODIUM AND WATER EXCHANGE IN THE TROUT EGG. Jour. Cell. and Comp. Physiol. 54(2): 153-162; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40066. 1960.

Experiments with fresh, water-hardened trout

eggs showed a definite, but limited, permeability to anions and cations and to water on the part of the egg's yolk sac at a time when no perceptible change in egg weight occurred. The conclusions were based primarily upon the presence within the egg yolk of tracer materials originally placed into the medium. Another finding of interest was the observation that heating the eggs before the experiment caused a large increase in the size of the exchangeable sodium chloride pool. Ancillary experiments included studies of total electrolyte content and, also, penetration of radioactive iodide ion into the egg. (Auth. summ.)

3748. Ahjar, M. 1956. THE INLAND FISHERIES EXTENSION SERVICES IN INDONESIA. Indo-Pacific Fish. Coun. Proc. 6(2/3): 306-307; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40273. 1960

Fisheries Extension officers and their duties, courses given, talks, demonstrations, exhibitions, brochures and other processes of federal and regional government in Indonesia were discussed. The main aims and achievements were stated as: production of more fish fry; better quality of breeders, spawners and fry; better feeding and manuring; proper density of stocking; better storage and transporting methods; preservation methods; water regulations; better equipment; cooperative societies, fish conservation in lakes, swamps and rivers, and eradication of pests, diseases, etc. (MDS)

3749. Collier, Joe E. 1959. CHANGES IN FISH POPULATIONS AND FOOD HABITS OF YELLOW BASS IN NORTH TWIN LAKE, 1956-1958. Proc. Iowa Acad. Sci. 66: 518-522; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40280. 1960.

Fish population studies initiated in 1953 indicated that most species were on the increase until the winter kill of 1955. In 1956, populations were below normal; in 1957 there was an increase in most species, followed by a decrease in 1958. Studies during 1953 and 1954 showed that the food of adult yellow bass consisted to a great extent of young-of-the-year yellow bass and gizzard shad, along with insects. During the summers of 1956, 1957, and 1958, forage fish were of very minor importance in the diet of yellow bass; they fed mainly on immature insects and minute crustacea. (Auth. abst.)

3750. Dannevig, Alf. 1959. FLUCTUATIONS IN THE ABUNDANCE OF SOME FISHES ON THE (NORWEGIAN) SKAGERRAK COAST. (VEKSLINGER I FOREKOMSTEN AV FORSKJELLIGE FISKESLAG PA SKAGERAKKYSTEN.) Fiskeridirekt. Skrifter, Ser. Fisk. 4(3):1-32; Biological Abstracts, Vol. 35, No. 15; Abst. No. 40282. 1960.

Fish abundance varies markedly because of salinity and temperature variance caused by the cold low-saline Baltic Current, which also retains its character northbound along the Norwegian Coast. This current is large and on the surface during the spring and summer, but small and deep in winter. Its position shifts with wind and tide; thus local

coastal waters may often consist of warm saline North Sea water instead, and temperatures may change 7°C in one day. Deep fjord waters often stagnate and fish avoid them. Cod (*Gadus morrhua*) spawn best when temperatures reach about 6°C, usually in March. An earlier spawn may result in death of eggs or fry from subsequent cold periods, or from lack of the plankton that blooms in March; a later spawn insures good survival. Herring (*Clupea harengus*) spawn at about 4°C and never occur in the cold Baltic Current; mackerel (*Scomber scombrus*), at about 12°C and always seek the warmest waters. The great autumn-spawning herring fishery in the years 1880 to 1890 ceased in 1894 and this type of herring has not reappeared. In that period, spent herring, young herring, and mackerel occurred in the skerries and fjords every winter, but disappeared in 1910. Then spring-spawning herring became abundant. During 1914 to 1918 pollack (*Pollachius pollachius*) became the most common food fish but then declined to about one third its earlier abundance. Abundant cod in the period 1917-1929 have decreased since then to about one half in the 1950's. Whiting (*Merlangus merlangus*) have become increasingly common. (R. P. E.)

3751. DeGodoy, M. P. 1959. AGE, GROWTH, SEXUAL MATURITY, BEHAVIOR, MIGRATION, TAGGING AND TRANSPLANTATION OF THE CIRIMBATA (*PROCHILODUS SCROFA* STEINDACHNER, 1881) OF THE MOGI GUASSU RIVER, SAO PAULO STATE, BRASIL. An. Acad. Brasil Cienc. 31(3): 447-477; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40283. 1960.

The curimbata, a characinid fish, migrates in large schools up and down the river for spawning, sometimes traveling at the rate of 6-9 miles per day upstream and covering as much as 700 miles in the round trip. Males become sexually mature at 2 years of age, females at 3; males continue active for 9 years, females to 13. The schools contain both sexes in the ratio of 1.05 males to 1 female, with the majority of each sex being from 5 to 7 years of age. At that age both sexes are of about the same length although the females are nearly twice as heavy as the males. The males do not increase in length much after the 7th year, but the females continue to grow throughout their entire life. Age of the fish can be readily ascertained by counting the well-marked annuli appearing on their cycloid scales. This regular annual migration seems to follow the spawning act and is maintained as long as the fish remain in their own river. Fish tagged and transferred to interconnected branches of the river system do not return to home waters. Most frequently such transplants will spawn normally, but not attempt any migration upstream following spawning. If attempted, the distance traveled is relatively short. If transferred back to home waters, normal migration habits are resumed at the proper time the next season. (A. C. W.)

3752. Frank, S. 1959. GROWTH OF THE ROACH (*Rutilus rutilus*), WHITE BREAM (*Blicca bjoerkna*) AND RUDD (*Scardinius erythroph-*

THALMUS) IN THE SLAPY DAM (BOHEMIA). (RÚST PLOTICE OBEČNE, CEJNKA MALEHO A PERLINA OSTROBRICHO VE SLAPSKÉ UDOLNÍ NADRŽI.) Zool. Listy 22(4): 357-364; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40290. 1960.

The age and growth of the roach, white bream and rudd are reported from data on the growth of the scales. All 3 species occur regularly in large numbers in the slowly-flowing streams of Czechoslovakia. This includes the dam of Slapy where these species grow well. However, according to OLIVA, the excessively large, slowly-growing populations, especially of roach and white bream, cause great competition for food for the economically important carp. It is recommended that the roach, white bream and rudd be caught intensively, both by rod and net, throughout the entire year, providing this does not lead to scarcity of these fish, which would be reflected in very rapid growth. (MDS)

3753. Kawada, S. 1956. CURRENT STATUS OF FISH FINDERS IN JAPAN. Indo-Pacific Fish. Council. Proc. 6(2/3): 265-267; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40293. 1960.

The use of ultrasonic echoes of 10-100 KC, and for special purposes 200-300 KC, for locating schools is well known. Benefits from such methods in regard to location and behavior of schools in set nets, vertical distributions and surveys were cited. This information applied particularly to horse mackerel, sardines, Alaska pollack, herring, squid and shark. (MDS)

3754. Mayhew, James. THE USE OF TOXAPHENE AS A FISH POISON IN STRIP MINE PONDS WITH VARYING PHYSICAL AND CHEMICAL CHARACTERISTICS. Proc. Iowa Acad. Sci. 66:513-517; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40301. 1960.

Fifteen ponds were treated with toxaphene concentrations that varied from 0.01 to 0.1 parts per million. Preliminary studies revealed wide variations in the chemical and physical features of the ponds. Approximately 3500 pounds of fish were killed. Carp, gizzard shad, and quillback were the most numerous; other species included largemouth bass, bigmouth buffalo, black crappie, black bullhead, bluegill, yellow bass, and channel catfish. Detoxification studies were conducted on five ponds. The first pond detoxified within 90 days; two remained toxic to fishes for 270 days. Factors important to the duration of toxicity are discussed. (Auth. abst.)

3755. Menon, M. D., and P. I. Chacko. 1956. FOOD AND FEEDING HABITS OF FRESHWATER FISHES OF MADRAS STATE, INDIA. Indo-Pacific Fish. Council. Proc. 6(2/3): 182-186; Biological Abstracts, Vol. 35, No. 14, Abst. No. 40302. 1960.

Stomach contents of 20 planktonic feeders, 11 insect eaters, 13 bottom feeders, 3 plant feeders, 1 column feeder (*Barbus chrysopoma*) and 11 carnivorous fish-eating species were examined and con-

sidered under these 6 groupings. Column feeders were defined as fishes that feed on the larger crustaceans such as the shrimp *Caridina* species. The authors emphasized the role of balanced fish population according to feeding habits, and noted that aside from food fish production, many of the fishes had use in reducing obnoxious algal blooms and reducing "waterborne diseases", e.g., *Gambusia affinis*, *Aplocheilichthys lineatus* and others, control of mosquito larvae; *Ambassis ranga*, *A. nama* and *Chela clupeoides* for the reduction of copepod numbers; and the carp *Catla catla* for the reduction of mollusk numbers. (MDS)

3756. Rasalan, S. B., and B. Datingaling. 1956. OBSERVATIONS ON FISHING WITH LIGHT IN THE PHILIPPINES. Indo-Pacific Fish. Council. Proc. 6(2/3): 275; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40316. 1960.

Lights used range from hand torches to banks of 16 bulbs of 1,000 watts. The authors discussed arguments regarding the use of lights to decoy fish. Fishermen sometimes object to the use of the strong lights. Lights can interfere with the sighting of fluorescence in the surface water, which on dark nights indicates the presence of a school of fish. (MDS)

3757. Schmulbach, James C. 1959. GROWTH OF THE WALLEYE IN THE DES MOINES RIVER, BOONE COUNTY, IOWA. Proc. Iowa Acad. Sci. 66: 523-533; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40321. 1960.

Even though the habitat is marginal, a considerable fishery exists for walleyes in the Des Moines River. Tagging studies indicate the annual rate of harvest to be about 10 percent. The size of the population is evidently limited by frequent fish kills due to high water temperatures in the summer and oxygen depletion in the winter. Considerable variation in growth exists within age groups and between year classes. Possible explanations include: (1) sexual differences, especially between fish over four years old; (2) frequent fish kills which result in vacancies in the habitat; (3) low water levels during certain years; and (4) frequent stocking of fry, fingerlings, and yearlings during different seasons. The growth and general well-being of Des Moines river walleyes are about average when compared with those in other parts of the country. (Auth. abst.)

3758. Takayama, S. 1956. FISHING WITH LIGHT IN JAPAN. Indo-Pacific Fish. Council. Proc. 6(2/3): 276-277; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40324. 1960.

Blue light is preferable for gathering fish from a large range. The phototaxis of sardine schools is in the range of about 10^{-2} lux, daylight color. Two units of 500 watts each, placed at different places are recommended; one of the light sources should be moved gradually toward the other, drawing 2 schools of attracted fish together. This method is adopted in purse, seine and lift net fishing. When a strong light is used, the fish avoid the zone directly under the light; sardine schools react thus at 600 lux. Submerged bulbs may

be useful at 1 to 20 m, and ordinary light bulbs will resist water pressure in this depth range. About 1/4 of the total marine catch in Japan is harvested with the aid of lights; they are used by about 1,000 units in the sardine, mackerel, and horse-mackerel purse-seine fishery, by 1,654 units in the saury fishery with stick-held lift nets, by 15,818 units in the mackerel and horse-mackerel angling fishery, and by 48,484 units in the squid angling fishery. Regulations on the use and wattage of lights are expressly restricted to small coastal fisheries to control undue competition, and no adverse effects on fish have been noted. Fish schools at the breeding stage have no phototaxis. (MDS)

3759. Tunison, A. V. 1959. FEEDING OF TROUT. (ALIMENTACION DE LA TRUCHA.) Montes (Madrid) 15(88/89): 367-374; 463-470; Biological Abstracts, Vol. 35, No. 15, Abst. No. 40327. 1960.

This paper discusses the food requirements and growth of hatchery-raised trout, for various sizes of fish and temperatures of water. (W.N.S.)

3760. Oberg, Karl-Eric. 1959. THE STRUCTURE OF GILL EPITHELIUM AND THE CIRCULATION IN GILLS OF FISHES POISONED WITH ROTENONE. Arkiv Zool. 12(4): 383-386; Biological Abstracts, Vol. 35, No. 15, Abst. No. 41469. 1960.

Gills from fish (*Leuciscus rutilus*) which had lost their equilibrium due to treatment with 1 mg/liter Noxfish, were fixed with Boin's fluid, stained with iron hematoxylin according to Heidenhain, and examined microscopically. By a transillumination apparatus the circulation of blood was studied in the gills of fish treated with the same rotenone concentration. No histolysis had occurred in the gill epithelium of rotenone-treated fish. The blood circulation in the gills was not lowered, but was quite normal in comparison with control animals. (Auth. summ.)

3761. Elegido Alonso-Geta, Maximiliano. 1959. STUDY ON THE FORMATION OF SCALES OF ATLANTIC SALMON. (ESTUDIO SOBRE LA FORMACION DE LAS ESCAMAS DEL SALMON ATLANTICO.) Montes (Madrid) 15(90): 555-560; Biological Abstracts, Vol. 35, No. 15, Abst. No. 43153. 1960.

The author discusses the development of scales of salmon, and their relation to the life history of the fish. He describes the method of preparing scales for study, and the apparatus used. (W.N.S.)

3762. Randall, John E., and Vernon E. Brock. 1960. OBSERVATIONS ON THE ECOLOGY OF EPINEPHELINAE AND LUTJANID FISHES OF THE SOCIETY ISLANDS, WITH EMPHASIS ON FOOD HABITS. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 9-16.

Food habits and habitats frequented by several groupers (Epinephelinae) and snappers (Lutjanidae) of the Society Islands were investigated preliminary to the introduction into Hawaiian waters from French Oceania of selected inshore marine fishes of food

and sport-fishing value. Fifteen species of groupers and 14 snappers which do not occur in the Hawaiian chain were collected in Tahiti and Moorea. Stomach contents of 1,305 specimens of 16 species were examined. Of these, 1,131 were from the snapper, *Lutjanus vaigiensis*, and the two groupers, *Epinephelus merra* and *Cephalopholis argus*, these three species being the most important market fishes of these two groups in Tahiti. *E. merra* is common in lagoons, and about two-thirds of the specimens had fed on benthic crustaceans (principally crabs) and the rest mostly on fishes. During the southern summer, however, when juvenile fishes were abundant on the reefs, fish made up three-fourths of the diet. *C. argus* is the dominant carnivorous fish on outer reefs but is also found in lagoons. More than three-fourths of the stomachs of this species contained fishes and the rest benthic crustaceans. *L. vaigiensis*, also a fish of diverse habitats, consumes fishes and crustacea in about equal amounts. Very few of the fishes found in the stomachs of these three species are of commercial importance. (Auth. abst.)

3763. Whitmore, Cecil M., Charles E. Warren, and Peter Doudoroff. 1960. AVOIDANCE REACTIONS OF SALMONID AND CENTRARCHID FISHES TO LOW OXYGEN CONCENTRATIONS. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 17-26.

All of four fish species used in 174 laboratory experiments with a "channeled avoidance tank" avoided some low oxygen concentrations, the degree of avoidance generally decreasing with increasing concentration. Avoidance indices computed were based on numbers of entries into two experimental channels with reduced oxygen concentrations and two control channels, on numbers of crossings of a transverse line located well inside each channel, and on numbers of fish observed in the channels at 60-second intervals. Juvenile chinook salmon showed marked avoidance of oxygen concentrations near 1.5, 3.0, and 4.5 mg./l. in summer at high temperatures. A decrease of the avoidance observed in the fall is ascribable to lower temperatures. The chinook salmon showed little avoidance of concentrations near 4.5 mg./l. in the fall, and no avoidance of concentrations near 6.0 mg./l. at any time. At summer temperatures juvenile coho salmon showed some avoidance of all the above oxygen concentrations, including 6 mg./l., but their behavior was erratic and their avoidance of concentrations near 4.5 mg./l. and less was not as pronounced as that of chinook salmon at corresponding temperatures. Largemouth bass and bluegill markedly avoided concentrations near 1.5 mg./l., but showed little or no avoidance of the higher concentrations, only the bass showing any avoidance of concentrations near 4.5 mg./l. The nature and significance of the observed avoidance reactions are not quite clear. The prompt avoidance by some fish of oxygen concentrations well above those known to be lethal cannot be ascribed entirely to mere stimulation or increase of activity due to oxygen deficiency. It may not be assumed, however, that oxygen concentrations avoided under the experimental conditions are usually avoided like-

wise under natural conditions. (Auth. Abst.)

3764. McCaig, Robert S., and James W. Mullan. 1960. GROWTH OF EIGHT SPECIES OF FISHES IN QUABBIN RESERVOIR, MASSACHUSETTS, IN RELATION TO AGE OF RESERVOIR AND INTRODUCTION OF SMELT. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 27-31.

Growth rates of eight species of fish taken by angling from Quabbin Reservoir, a 25,000-acre impoundment in Massachusetts, were determined for all or two of the following three periods of the reservoir's history: A--while the reservoir was filling; B--during the first 7 years after it had filled; and C--after the smelt had been introduced. Growth of yellow perch (Perca flavescens) showed little change over the three periods; that of white perch (Morone americana) declined. Growth of smallmouth bass (Micropterus dolomieu) and chain pickerel (Esox niger) increased somewhat after introduction of smelt but that of black crappie (Pomoxis nigromaculatus) and largemouth bass (Micropterus salmoides) remained essentially unchanged. There was a marked increase in growth rates of lake trout (Salvelinus namaycush) and brown trout (Salmo trutta) after smelt had become abundant (1954-1958). The proportion of game fishes (black basses, pickerel, and trouts) in the total angling catch increased from 2.1 to 5.4 percent by numbers and 11.0 to 23.0 percent by weight after introduction of smelt. Average angling yield in this deep, soft-water reservoir is 2.5 pounds per acre per year. (Auth. abst.)

3765. Hoopes, David Townsend. 1960. UTILIZATION OF MAYFLIES AND CADDIS FLIES BY SOME MISSISSIPPI RIVER FISHES. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 32-34.

At sampling stations in the Mississippi River near Keokuk, Iowa, during 1958 mayfly naiads, Hexagenia spp., comprised over 50 percent by volume of the food of channel catfish (Ictalurus punctatus), freshwater drum (Aplodinotus grunniens), mooneyes (Hiodon tergisus), goldeyes (Hiodon alosoides), and white bass (Roccus chrysops), and over 40 percent of the food of paddlefish (Polyodon spathula) and white crappies (Pomoxis annularis). These naiads were also eaten by shovelnose sturgeon (Scaphirhynchus platyrhynchus). Larval caddis flies, Potamyia flava, comprised over 60 percent of the food of the shovelnose sturgeon and between 10 and 20 percent of the food of mooneyes, goldeyes, and white crappies. The Hexagenia naiads found in the stomachs are the same kinds that ordinarily create a problem in the river communities but the nuisance species of caddis flies (Cheumatopsyche campyla and Hydropsyche orris) are not usually significant in the diets of the fish studied. (Auth. abst.)

3766. Vincent, Robert E. 1960. SOME INFLUENCES OF DOMESTICATION UPON THREE STOCKS OF BROOK TROUT (SALVELINUS FONTINALIS

MITCHILL). Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 35-52.

Three stocks of brook trout--domestic, wild, and first generation removed from wild stock--were tested and observed for effects of domestication. The domestic stock had been selectively bred for 90 years whereas the wild stock came from an isolated lake in the Adirondack Mountains. To reduce differential environmental influence to a minimum, the three lots were reared from eggs in adjacent rearing troughs at the same water temperature. After 1 year under these hatchery conditions the domestic fish were 5.2 inches in length and the wild, 3.6 inches. Throughout the rearing domestic stock were tamer and exhibited less fright than wild-stock fish. Laboratory tests showed that wild stock could stand a greater concentration of accumulated metabolites, that they could endure higher water temperature, and that domestic stock had a surface response whereby they moved to the surface of a rearing trough or a tall aquarium. Domestic fish also lacked the desire to conceal themselves. Stamina tests conducted by swimming 1,522 fish individually until exhausted in a small trough showed that the wild stock had greater stamina throughout the size range tested. Survival trials in a small stream and a pond indicated that wild fish experienced less mortality and had growth rate similar to or better than domestic fish in both habitats. After 73 days in the small stream 20 percent of the domestic and 33 percent of the wild stock survived. Domestic fish grew 0.34 inches and wild fish, 0.48 inches. Survival was 43 percent for the domestic and 65 percent for the wild after 108 days in a pond, while length increase was 2.6 inches for the domestic and 2.5 inches for the wild stock. The domestic increased more in weight. After being in a pond for nearly 4 months, the domestic stock had acquired little wariness. (Auth. abst.)

3767. Moyle, John B., and Richard Lound. 1960. CONFIDENCE LIMITS ASSOCIATED WITH MEANS AND MEDIANS OF SERIES OF NET CATCHES. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 53-58.

Statistical methods for determining errors associated with means and medians of series of catches in stationary nets are discussed and two suggested methods presented: a parametric method based on the negative binomial distribution and a non-parametric method using sequential ranking of values around the median. It is concluded that the former is most useful from the viewpoint of mathematical description, and the latter is of greatest value where the number of net sets is small and fish of a particular kind are taken in most of the sets. (Auth. abst.)

3768. Warner, Kendall, and Ivan R. Porter. 1960. EXPERIMENTAL IMPROVEMENT OF A BULLDOZED TROUT STREAM IN NORTHERN MAINE. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 59-63.

Brook-trout habitat in Big Hudson Brook was destroyed in 1950 by extensive bulldozing in preparation for pulpwood driving. Following bulldozing, the

brook had no well-defined channel at low water levels, water temperatures reached the mid-seventies, and the small flow seeped through bottom rubble. Although restoration or original habitat conditions was impossible, an attempt was made, using a bulldozer, to improve trout-stream habitat that had been destroyed earlier by bulldozing. Seventy-one wing deflectors, 10 rock dams, and 6 spring holes were created by a single bulldozer in 3 working days. Evaluation of the work 2 years later showed that 63 deflectors had successfully narrowed stream flow or created pools, rock dams were largely unsuccessful, and pools created by excavation of spring areas commonly harbored trout during warm summer weather. (Auth. abst.)

3769. Economon, Philip P., and Robert E. Schumacher. 1960. UNIFORMITY OF DISPERSION OF SULFAMERAZINE IN PELLETED TROUT FOOD. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 64-66.

Medicated food pellets for trout were prepared using 1.5 percent by weight sulfamerazine. Mixing and pelleting methods are described. Samples of pellets, taken at random during pelleting were analyzed colorimetrically for sulfamerazine 2 days after pelleting and after storage of the pellets at 41°F. for 2 months. The sulfamerazine was found to be quite evenly mixed in the pellets and no loss detected after storage for 2 months. (Auth. abst.)

3770. Lux, Fred E., and Lloyd L. Smith, Jr. 1960. SOME FACTORS INFLUENCING SEASONAL CHANGES IN ANGLER CATCH IN A MINNESOTA LAKE. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 67-79.

An investigation was undertaken in a small Minnesota lake to determine the relationship between angler success for northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and crappie (*Pomoxis nigromaculatus*) and food availability and food selectivity by these species. Fishing success was determined by creel census and food selectivity by stomach analysis of angler-caught fish. Food availability was determined by bottom sampling and shore seining for small fish. Over a 3-year period anglers' catch was highest in June and lowest in late summer. Angling success was inversely related to food availability and food intake, but changes in physical and chemical factors did not appear to be related to rate of angler take. (Auth. abst.)

3771. Allen, George H., and Leighton G. Claussen. 1960. SELECTIVITY OF FOOD BY BROOK TROUT IN A WYOMING BEAVER POND. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 80-81.

On September 9, 1952, the dam of a small beaver pond, located on the east slope of the Medicine Bow mountains of Wyoming, was dynamited by the Wyoming Game and Fish Department. A sample of 62 brook trout (*Salvelinus fontinalis*) was collected after the water had drained from the pond.

Stomachs of the trout were preserved in formalin. Since each stomach had been identified by number, it was possible to compare by age, sex, and size the feeding behavior of brook trout for a single day.

3772. McCARRAHER, D. B. 1960. PIKE HYBRIDS (*ESOX LUCIUS* X *E. VERMICULATUS*) IN A SAND-HILL LAKE, NEBRASKA. Transactions of the American Fisheries Society, Vol. 89, No. 1, pp. 82-83.

The first probable *lucius* x *vermiculatus* hybrid found in Nebraska was taken during the ice-fishing season of 1958-59. It was caught on hook and line in Watts Lake, 2,230-acre lake on Valentine National Wildlife Refuge. During the ice-fishing season two other hybrids are known to have been caught from this same lake.

Trammel and fyke netting on Watts Lake in the early spring of 1959 produced three additional hybrid fish. Coloration and marking of the Nebraska hybrids resembles closely that of grass pickerel: Alternating dark and light bars extend obliquely forward and ventrally to the lateral margin of the belly. The bars are irregular with slight fuzzing or blotching along the dorsal body surface in two of the specimens. Body color is generally dark.

3773. Franklin, Donald R., and Lloyd L. Smith, Jr. 1960. NOTE ON DEVELOPMENT OF SCALE PATTERNS IN THE NORTHERN PIKE, *ESOX LUCIUS* L. Transactions of the American Fisheries Society, Vol. 89, No. 1, pg. 83.

Fish less than 30.5 millimeters in length had not started to form scales. Fish between 30.2 and 35.0 millimeters had formed from one-half to one and one-half rows of scales. The first scales form all along the lateral line, with the first row usually appearing below rather than on the caudal peduncle as in many species. The fish in the 40.0- to 45.0-millimeter range had formed from 6 to 10 scale rows and only the dorsal and ventral midlines were not scaled at 60.0-63.0 millimeters. Complete scalation was noted in fish as short as 66.5 millimeters.

3774. Swingle, H. S. 1960. COMPARATIVE EVALUATION OF TWO TILAPIAS AS POND FISHES IN ALABAMA. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 142-148.

The Java tilapia, *Tilapia mossambica*, is a very efficient pondfish. Total production in ponds stocked with brood fish varied with different rates of feeding from 1,477.1 pounds per acre in 168 days to 4,383.9 pounds per acre in 191 days. Total production varied from 771.1 pounds per acre in 123 days in ponds stocked with 4,000 fingerlings to 2,945.7 pounds per acre in 111 days in those stocked with 20,000 fingerlings. The Nile tilapia, *Tilapia nilotica*, in limited tests with feeding, yielded a maximum of 4,003.7 pounds per acre in 208 days with adult stocking and 2,380 pounds per acre in 113 days with a stocking of 16,000 fingerlings. Combinations of largemouth bass, *Micropterus salmoides*, and the Java tilapia produced a higher percentage of harvestable-sized tilapia (6 inches or more) and a smaller total pro-

duction than tilapia used alone. Highest production of harvestable fish was obtained by delaying stocking of bass until August, when many tilapias were too large to be eaten. Tilapias spawned when stocked into established bass-bluegill populations, but very few young survived. Tilapias hatched late in April or early in May reached sizes from 6 to 8 inches within 3 months when adequately fed. The channel catfish, *Ictalurus punctatus*, the Java tilapia, and the Nile tilapia were almost equally efficient in food conversion and were superior to common carp, *Cyprinus carpio*, and the speckled bullhead, *Ictalurus nebulosus marmoratus*. Maximum productions of harvestable fish per acre during one growing season in Alabama were 2,453.1 pounds for the Java tilapia, 2,233.6 pounds for the channel catfish within 191 days, 113 days, and 252 days, respectively. Increasing rates of stocking of fingerling tilapias decreased rates of reproduction, indicating possible presence of a repressive factor affecting reproduction. The Nile tilapia appeared to be more readily affected and populations of this species contained a higher percentage of harvestable sized fish than the Java tilapia. Ponds stocked with brood tilapias April 15 to 20, were opened to fishing the following August. The maximum catch per acre was 593.6 pounds in 1957 and 590.6 pounds in 1958 in ponds stocked with the Java tilapia. The Nile tilapia grew to larger size but were less readily caught by fishermen. The catch of this species was only 128 pounds in a pond containing 1,621 pounds of harvestable tilapia per acre. (Auth. abst.)

3775. Fry, F. E. J., D. Cucin, J. C. Kennedy, and A. Papson. 1960. THE USE OF LEAD VERSENATE TO PLACE A TIME MARK ON FISH SCALES. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 149-153.

Injection of 5 to 7 percent lead disodium versenate at a level of 50 milligrams per kilogram body weight consistently produced satisfactory deposits of lead in the scales of whitefish and lake trout and appears to offer advantages over the original lead-acetate method of Hiyama and Ichikawa for producing time marks. The injection appeared to have no effect on mortality of growth, but it was not established whether the handling produced a check in the scale growth. As with injection with lead acetate, lead is deposited in the scale at the margin within a few days of injection (probably 1 or 2). Growth of the scale and the body were shown to be closely proportional in the whitefish over a period of a year. The results of a few preliminary experiments to compare the efficiencies of lead acetate and lead versenate as producers of lead lines on fish scales are also reported. The methods of preparation of the lead versenate and of developing the lead lines are given. (Auth. abst.)

3776. Massmann, William H., and Anthony L. Pacheco. 1960. DISAPPEARANCE OF YOUNG ATLANTIC CROAKERS FROM THE YORK RIVER, VIRGINIA. Transactions of the American Fisheries

Society, Vol. 89, No. 2, pp. 154-159.

Virginia catches of the Atlantic croaker, which declined from 55 million pounds in 1945 to 3 1/2 million pounds in 1952, apparently began to recover in 1955, reaching a total of 9 1/2 million pounds. Recent information suggests that catches are again declining. Length measurements on croakers from commercial pound-net catches made since 1950 show a general increase in length and therefore average age of fish since 1954. Monthly young fish surveys made in croaker nursery areas of lower Chesapeake Bay and York and Pamunkey rivers indicate differences in the relative abundance of young croakers from one year to the next. The winter season of 1957-1958 was especially unique in that considerable numbers of young were present in the fall but disappeared in mid-winter. The disappearance of young croakers occurred during a period when water temperatures dropped below those in preceding years. It is suggested that extreme low temperatures may have affected the abundance of young croakers. (Auth. abst.)

3777. Ross, A. J., J. Pelnar, and R. R. Rucker. 1960. A VIRUS-LIKE DISEASE OF CHINOOK[®] SALMON. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 160-163.

Consideration is given to a recurring disease of early feeding chinook salmon fingerlings at the Coleman, California, Federal Fish Cultural Station. The infection becomes manifest in the early spring months at low water temperatures and abates as the water temperature rises. Bacteriological studies have failed to yield the presence of a disease agent, either by cultural or staining procedures. The disease has been successfully transmitted from infected fish to healthy fish by the injection of bacteria-free filtrates prepared from diseased fish tissues. The causative agent is therefore believed to be a virus-like entity. (Auth. abst.)

3778. Eisler, Ronald, and Tadeusz Backiel. 1960. NARCOTIZATION OF CHINOOK SALMON FINGERLINGS WITH TRICAINE METHANESULFONATE (M.S. 222). Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 164-167.

Chinook salmon fingerlings were exposed to varying concentrations of tricaine methanesulfonate (M.S. 222) for a period of 5 minutes. Groups exposed to concentrations of 1:10,000 and greater experienced heavy mortality. Concentrations of 1:50,000 and less proved ineffective for narcotizing purposes. Experimental evidence indicates that the lowest concentration of the drug capable of narcotizing the test animals within the allotted time period is 1:33,000. Fingerlings can withstand this dose (1:33,000) for at least 105 minutes without ill effects but an immersion approaching 241 minutes is fatal. Fingerlings adapted to either a salt-water environment of 52°F. or to a fresh-water environment of 59°F. were narcotized with equal facility. During a 2-week observation period following recovery, no latent effects of narcotization were noted in any test animal. (Auth. abst.)

3779. Benson, Norman G. 1960. FACTORS INFLUENCING PRODUCTION OF IMMATURE CUTTHROAT TROUT IN ARNICA CREEK, YELLOWSTONE PARK. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 168-175.

Data are presented on the variations in production of immature cutthroat trout from Arnica Creek, a tributary of Yellowstone Lake, from 1951 to 1958. Of 36,786 immature trout counted, 87.3 percent were age-group 0. The highest production occurred during years when large numbers of age-group 0 trout migrated downstream to Yellowstone Lake from mid-July to mid-August, or soon after they emerged from the gravel. Ecological conditions associated with a large July-August migration were receding water levels and much light. High populations of age-group I and II trout in Arnica Creek, which are predacious on fry, did not appear to have as much influence on the production of good year classes as did the downstream migration pattern. No relationship between year-class variation of immatures and reappearance of these same year classes in the spawning runs was evident. The number of spawners or the time of spawning run did not bear any consistent relationship to the production of immatures. (Auth. abst.)

3780. McCombie, A. M., and F. E. J. Fry. 1960. SELECTIVITY OF GILL NETS FOR LAKE WHITEFISH, *COREGONUS CLUPEAFORMIS*. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 176-184.

The methods by which the curve of gill-net selectivity has been determined by various workers are discussed. An empirical demonstration of the normal curve of probability to the distribution of size classes of lake whitefish (*Coregonus clupeaformis*) in catches from experimental gangs of gill nets fished in South Bay, Lake Huron, from 1954 to 1958 is presented. A plot was made of the numbers of fish caught in each length class against the logarithms of the ratios of the girth of the fish to the perimeter of the mesh. An adjustment was made to allow for the presence of unequal numbers of the various length classes in the population fished. The curves for all length classes concerned when superimposed were found to be essentially the same and could be described by the normal frequency distribution with the mode at 0.100 and a standard deviation of ± 0.0514 , expressed as logarithms of fish girth to mesh perimeter. The efficiencies of nylon and cotton nets are discussed on the basis of the literature and of experiments in which gangs with alternate cotton and nylon nets were fished in South Bay. These experiments indicate that the nylon nets take about three times as many whitefish as the cotton, but take fish of essentially the same size composition. (Auth. abst.)

3781. Ridenhour, Richard L. 1960. DEVELOPMENT OF A PROGRAM TO SAMPLE YOUNG FISH IN A LAKE. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 185-192.

Need for a more efficient program to sample

young-of-the-year game and pan fish in Clear Lake, Iowa, led to an intensive survey conducted during the summers of 1956 and 1957. A seining schedule was followed in which weeks, times of day, and stations were randomized following the procedures for the Latin square design. On the basis of information gained from the 1956-1957 survey, a more efficient plan was outlined for integration into the Clear Lake fishery research program. Seining is to be limited to the night because catches of most species were higher then and the mean lengths of young fish are the same as those taken during daylight. Sampling will be according to a Latin square schedule during the 6 weeks prior to August 31. Sampling in the preceding week will permit practice and elimination of any procedural problems. Growth of young-of-the-year fishes differed in various parts of the lake necessitating sampling at several stations (Auth. abst.)

3782. Teter, Harold E. 1960. THE BOTTOM FAUNA OF LAKE HURON. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 193-197.

The examination of 63 bottom samples, collected in Lake Huron in 1952 and 1956, revealed that *Pontoporeia affinis* was the dominant organism in both deep and shallow water. The next abundant organisms in deep water were oligochaetes, finger-nail clams, and midge larvae. Midge larvae were more numerous than either oligochaetes or fingernail clams in shallow water. The number of organisms per square meter was similar to that determined from a similar study on Lake Michigan. (Auth. abst.)

3783. Tanner, Howard A. 1960. SOME CONSEQUENCES OF ADDING FERTILIZER TO FIVE MICHIGAN TROUT LAKES. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 198-205.

Inorganic fertilizer was applied to four of a group of six Michigan trout lakes. The thermocline in the three lakes receiving the most fertilizer shifted to a more shallow position. Three of the fertilized lakes decreased in total alkalinity at a greater rate than did the two lakes not fertilized. Fertilization resulted in the oxygen being depleted from the hypolimnion and some oxygen reduction occurred in the thermocline. The volume of oxygenated water remaining under the ice during the critical period of late winter was reduced in the fertilized lakes, and lakes fertilized at the highest rate very nearly approached winterkill conditions. The reduction of oxygen both in summer stagnation periods and in late winter was more severe after the second season of fertilization. (Auth. abst.)

3784. Hunt, Burton P. 1960. DIGESTION RATE AND FOOD CONSUMPTION OF FLORIDA GAR, WARMOUTH, AND LARGEMOUTH BASS. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 206-211.

Voluntary- and force-feeding experiments were conducted on 131 Florida gar (*Lepisosteus platyrhincus*), 46 warmouth (*Chaenobryttus gulosus*), and

21 largemouth bass (*Micropterus salmoides*) to determine the rate of ingestion and food consumption. The digestion rate of the warmouth was 1.6 times greater than that of the gar, and that of the bass was 1.5 times greater than the warmouth and 2.4 times greater than the gar. The daily voluntary food consumption of the warmouth was 1.6 times greater than the gar, and that of the bass 1.6 times that of the warmouth and 2.5 times greater than the gar. (Auth. abst.)

3785. Havey, Keith A. 1960. RECOVERY, GROWTH, AND MOVEMENT OF HATCHERY-REARED LAKE ATLANTIC SALMON AT LONG POND, MAINE. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 212-217.

Three groups of fin-clipped, hatchery-reared salmon, *Salmo salar*, stocked at Long Pond, Hancock County, Maine, between 1952 and 1954 yielded an estimated 4.0 percent return to anglers during the 4 years (1955-1958) following the final stocking. The individual groups of approximately 3,000 fall-stocked salmon (age-group I+) were recovered at rates of 5.0, 0.76, and 6.1 percent. Hatchery-reared salmon comprised over 90 percent of the total salmon catch during the census period. Creel-census methods are described. Open-water fishermen caught hatchery-reared salmon at a rate of 0.060 fish per line hour from 1955 to 1957 inclusive. Ice fishermen took 0.0047 salmon per line hour during the same years. From 1954 to 1958 ice fishermen expended 58.0 percent of the total fishing effort and took 14.8 percent of the salmon catch. Survival, growth, and exploitation rates of the different groups of salmon are compared and discussed. Forty-six of the 9,271 salmon stocked moved down the outlet of Long Pond in the 6-year period following the first stocking. Only one of these salmon continued on to sea. Management implications arising from the study are discussed. (Auth. abst.)

3786. Groves, Alan B. 1960. SWIMMING PERFORMANCE OF JUVENILE SOCKEYE SALMON IN SALT AND FRESH WATER. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 218-221.

An experiment was conducted to explore the hypothesis that the swimming performance of salmonoids in sea water is higher than that of similar fish in fresh water. Young sockeye salmon (*Oncorhynchus nerka*) swam longer in salt water. Duration of swimming increased with size of fish. (Auth. abst.)

3787. Kramer, Robert H., and Lloyd L. Smith, Jr. 1960. FIRST-YEAR GROWTH OF THE LARGE-MOUTH BASS, *MICROPTERUS SALMOIDES* (LACEPEDE), AND SOME RELATED ECOLOGICAL FACTORS. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 222-233.

First-year growth of largemouth bass taken from Lake George and adjoining slough, Anoka County, Minnesota, during a 4-year period was

described. Illumination, water chemistry, abundance of bass fingerlings, yearlings, and other fish did not influence growth rate or total season's growth. Total length at end of season varied from 56 to 85 millimeters and was contingent upon length attained on August 1, which was directly related to total temperature experience to that date. Rates of embryo development, sac-fry growth, and fingerling growth during the first 4 weeks and again at the end of the season were directly related to the mean daily water temperature. Growth rate during the first 2 weeks after rising was directly related to amount of food in stomachs, and near the end of the season to the ratio of large organisms to small organisms. Differences in relative condition factor (Kn) between areas in a single year were directly related to stomach weight, while differences in condition among years within an area were inversely related to abundance of bass fingerlings. No differences in growth between sexes were found. (Auth. abst.)

3788. Wallis, Orthello L. 1960. MANAGEMENT OF SPORT FISHING IN NATIONAL PARKS. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 234-238.

The National Park Service, entrusted with the perpetuation of natural aquatic conditions in areas it administers, manages recreational fishing so as to create minimum disturbances to these resources. In national parks and monuments angling cannot be managed independently of other park uses and features of significance. The objectives of the conservation of park fishery resources differ in some respects from those which govern programs in waters located outside park areas. The policy and program for the management of sport fishing are outlined. (Auth. abst.)

3789. Jensen, Albert C., and Raymond L. Fritz. 1960. OBSERVATIONS ON THE STOMACH CONTENTS OF THE SILVER HAKE. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 239-240.

In the present study of silver hake stomach contents, Crustacea and fishes were the most frequently found food items. Molluscs and Crustacea, mostly euphausiids, were found in approximately two-thirds of the stomachs of small (15 to 30 centimeters) fish and in more than two-thirds of the stomachs of medium-sized (31 to 45 centimeters) fish. Fish predominated only in the stomachs of large (46 to 60+ centimeters) silver hake. The silver hake is a voracious fish, capable of ingesting large prey fishes. In several instances the stomachs examined contained fishes nearly one-half the length of the predator. It frequently eats other silver hake.

3790. Economon, Philip. 1960. FURUNCULOSIS IN NORTHERN PIKE. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 240-241.

On May 15, 1959, two male northern pike (*Esox lucius*) 27 and 30 inches long were found dead in a spawning pond at Waterville, Minnesota, where they had been placed earlier as brood stock. It appears that this is the first time that northern pike infected

with A. salmonicida have been noted in nature in this country.

3791. Everhart, W. Harry, and Robert S. Rupp. 1960. BARB-TYPE PLASTIC FISH TAG. Transactions of the American Fisheries Society, Vol. 89, No. 2, pp. 241-242.

It was concluded that: (1) the barb-type plastic tag can be applied easily and quickly; (2) a more durable ink is needed for printing on the plastic tubing if the legend is to remain exposed; (3) the tag as presently made could be used for short-term experiments, since there seem to be no immediate effects such as tagging mortality or loss of tags; and (4) the tag is worth further development and testing.

3792. Dvially, Zsuzsa T. 1960. CALCULATION OF UNDERWATER DISTRIBUTION OF RADIANT ENERGY AS A PROBLEM OF PRODUCTION BIOLOGY. Acta Biologica, Vol. XI, No. 2, pp. 77-89.

A method is exposed, by which one of the basic problems of biological production in natural waters is solved--the exact calculation of the radiant energy passing under the surface of water.

The measurement of radiant energy, entering into water was until now an unsolved problem, because energy-measuring devices cannot be applied in underwater conditions. In such cases generally photo-electrical illumination-meters are used, and the energetical conditions are deduced from the electromotive force. But illumination is not proportional to radiant energy, so data read from scale of the illumination-meter (luxmeter) must be corrected by a new factor, which is the reciprocal value of the product of relative visibility and relative radiant energy. This corrected value is strictly proportional to the real quantity of underwater radiant energy. (Auth. abst.)

3793. Molnar, Gy. and I. Tolg. 1960. RONTGENOLOGIC INVESTIGATION OF THE DURATION OF GASTRIC DIGESTION IN THE PIKE-PERCH (LUCIOPERCA LUCIOPERCA L.). (UNTERSUCHUNG DER DAUER DER MAGENVERDAUUNG DES ZANDERS (LUCIOPERCA LUCIOPERCA L.) MITTELS EINER RONTGENOGLOISCHEN METHODE. Acta Biologica, Vol. XI, No. 2, pp. 103-108.

The paper describes a new method for the determination of the length of time required by the pike-perch (Lucioperca lucioperca L.) for gastric digestion. The new radiographic method makes it possible to keep the animals alive throughout the duration of the experiment. While the method enables us to ascertain the time of digestion in the stomach with great accuracy, it is not suitable for making similar observations in the intestines. (Auth. abst.)

3794. Halsband, E. 1959. VERANDERUNG DER ERYTHROZYTEN BEI REGENBOGENFORELLE (SALMO GARDNERII) UND KARPFFEN (CYPRINUS CARPIO) DURCH EINWIRKUNG VON GLEISH-STROM. Archiv fur Fischereiwissenschaft, Vol X,

No. 3, pp. 193-201.

The erythrocytes of carps and trouts in the electrical field (direct current) were investigated under the microscope by using various current-densities and times during which the current passes through the fish. In the first stage of reaction the blood cells move towards the anode (cataphoresis), in the second stage the form changes from oval to round, and in the final stage the cell dissolves. When using equal densities of current the blood cells of trout, as compared with carp, show the various changes already, when the current flows through the fish-body for a shorter time.

To investigate how the reaction depends on the degree of hydration of the blood cells, the experimental fishes were suited to the various salt-solutions.

When solutions were used which increased the degree of hydration of the cellular tissue, the stages of change occurred earlier in the electrical field, thus reducing the resistance of the cells to the effect of the electrical current.

When solutions were used which reduced the water content of the cells, the resistance of the blood cells increased. Longer periods for the current to pass the fish-body were necessary to cause the changes.

The necessary densities of current effecting a change in the blood cells are the multiple (about 1000 to 2000 times) of those values necessary for attracting or stunning the fish in the practical electrical fishery. The densities of current used in electrical fishery thus do not cause any direct changes of or damages to the blood cells of fish. (Auth. summ.)

3795. Grodzinski, Zygmunt. 1960. THE DEVELOPMENT OF THE BLOOD VESSELS IN THE TAIL OF THE SEA-TROUT, SALMO TRUTTA L. (ROZWOJ NACZYN KRWIONOSNYCH W OGONIE TROCI, SALMO TRUTTA L.) Acta Biologica Cracoviensis, Vol. II, No. 2, pp. 185-207.

The development of blood vessels in the tail of the Sea-trout embryos was investigated, both in preparations with their vessels filled with Indian ink and in live individuals. This process was parallel with the state of the surrounding tissues and organs.

The development of the following vessels was investigated in detail: the longitudinal caudal vessels, dorsal, lateral, and ventral segmental vessels, and the vessels of the caudal fin. The developmental gradient was found of the sequence in which the blood vessels make their appearance.

Attention was paid to the role of vascular nets in the formation and dwindling of vascular stems. But it was ascertained that many stems develop without passing the stage of vascular nets.

The distribution of the final blood vessels is influenced by the shape of the myomeres and by the arrangement of the skeleton e.g. fin rays.

The blood vessels correspond always to the transformations of neighbouring tissues or organs; they never precede them in development.

The connective tissue is a substratum upon which the blood vessels grow. (Auth. summ.)

3796. Jakubowski, Michal. 1960. THE STRUCTURE

AND VASCULARIZATION OF THE SKIN OF THE STONE-LOACH (*NEMACHILUS BARBATULUS* L.) AND BURBOT (*LOTA LOTA* L.). (BUDOWA I UNACZYNIE SKORY SLIZA (*NEMACHILUS BARBATULUS* L.) I MIETUSA (*LOTA LOTA* L.).) Acta Biologica Cracoviensia, Vol. II, No. 2, pp. 129-149.

The structure and the vascularization of the skin of the Stone-Loach *Nemachilus barbatulus* L. and of Burbot *Lota lota* L. were examined.

The epidermis has a strongly developed layer of glandular cells which is several times thicker than the germinative and cover layers taken together.

In both these species the dermal layer of the skin of the head is the thinnest. There is a lack of scales in these regions or, if they are present, they are smaller than elsewhere. The epidermis of the Stone-Loach is everywhere thicker than the dermis. In the Burbot these two components are of more or less equal thickness, with the exception of the head.

Under the epidermis, in the spongy layer of the dermis, the vessels form a subepithelial net with irregular meshes. In the Burbot, the net of vessels becomes more dense in the vicinity of the scales.

In the Burbot the best vascularization is found in the skin of the tail, the weakest in the head skin.

In both Stone-Loach and Burbot the sense organs of the epidermis are vascularized by small looplike branches of subepithelial vessels. In the Stone-Loach their number is greatest on the head. (Auth. summ.)

3797. Byczkowska-Smyk, Wanda. 1960. THE RESPIRATORY SURFACE OF THE GILLS IN TELEOSTS. PART IV. --THE RESPIRATORY SURFACE OF THE GILLS IN THE PIKE (*ESOX LUCIUS* L.), STONE-PERCH (*ACERINA CERNUA* L.) AND BURBOT (*LOTA LOTA* L.). (POWIERZCHNIA ODDECHOWA SKRZEL RYB KOSTNOSZKIELETOWYCH. CZESC IV. --POWIERZCHNIA ODDECHOWA SKRZEL SZCZUPAKA (*ESOX LUCIUS* L.), JAZGARZA (*ACERINA CERNUA* L.) I MIETUSA (*LOTA LOTA* L.).) Acta Biologica Cracoviensia, Vol. II, No. 2, pp. 113-127.

Ten specimens of Pike, Stone-Perch, and Burbot were investigated. The blood vessels of all specimens were injected with Indian ink, fixed in 4% formalin, and rendered transparent in terpeneol oil. The surface of the capillary blood vessels in the respiratory plates was measured. In these vessels gaseous exchange between blood and water takes place.

The greatest number of branchial lamellae was found on 1st arch, the smallest on the 4th.

The total length of all branchial lamellae was also measured. The number of respiratory plates for 1 mm of length of a lamella was calculated as well as the total amount of respiratory plates in each individual.

The total surface of all respiratory plates and the surface of capillary vessels contained in those plates was calculated separately for each specimen.

3798. Onodera, Kosi. 1960. ON THE RATIO

ESTIMATION OF CATCH IN CREEL CENSUS-- I. CORRECTIVE COEFFICIENT OF CATCH. Bulletin of Freshwater Fisheries Research Laboratory, Vol. 9, No. 2, pp. 25-42.

The total number of fishermen were censused by assigned census clerk who measured the catch of each angler at the time he contacted the fishermen. Also, the author organized teams composed of more than two investigators and examined the mode of adding and reducing anglers against these censuses as a check.

Then the pattern of accumulation of catch was constructed with sample fishermen taken from the check survey. To construct and analyze these patterns, some concepts were defined. For the ratio estimation, a corrective coefficient was applied. The corrective coefficient of catch showed rather definite value of about 1.5 for a two-hour sample. The total amount of catch surveyed by census clerk should be applied 1.5 to get true estimate of total catch for the period.

3799. Szubinska-Kilarska, Barbara. 1960. MORFOLOGIA ZOLTKA NIEKTORYCH RYB LOSOSIOWATYCH--THE MORPHOLOGY OF THE YOLK IN CERTAIN SALMONIDAE. Acta Biologica Cracoviensia, Vol. II, No. 1, pp. 97-111.

The morphology and some physico-chemical properties of the yolk in salmon, rainbow-trout, grayling, whitefish, and ablen were investigated. It was found that the yolk of salmon and rainbow-trout consists of the fluid ichthulin and fat crops as the only morphotic components. In the yolk of grayling, whitefish, and ablen, however, yolk spheres are to be found besides. Ichthulin is an aqueous suspension of protein substances. Owing to the presence of globulins it coagulates in water, and also in some hypotonic solution of NaCl. Fat drops in the fishes examined consist probably of glycerids only. Both in the ichthulin and in the fat drops probably fatty acids or phospholipids are precipitated as needle-like crystals, when treated with steapsin or sometimes without it. The yolk spheres are vesicles with thin semipermeable membrane. Their interior is filled with fluid. The membranes of the yolk spheres contain protein and a substantial amount of fatty components. The fluid within the yolk spheres is optically homogeneous. It consists of a suspension of proteins and fats which are in a state of unsteady equilibrium, because currents of osmotic origin may easily precipitate fat from this mixture.

3800. Jones, Rodney. 1960. MESH SELECTION AND APPARENT GROWTH OF HADDOCK. Journal Du Conseil, Vol. XXV, No. 2, pp. 177-184.

Mesh selection results in a differential survival rate amongst fish of the same age but of different lengths. This influences the mean length at each age by making it less than it would have been if there had been no "selection effect". The probable magnitude of this effect in the North Sea haddock is calculated and found to vary with the age of the fish, the area from which they come, and the mesh size used in the commercial fishery. Also, it affords a partial

explanation of Lee's phenomenon as it accounts for a differential mortality of fast and slow growing fish for at least a short part of their lives. (Auth. summ.)

3801. Frioriksson, Arni, Olav Aasen, and Arne Revheim. 1960. NEW IMPLEMENTS FOR FISH TAGGING. *Journal Du Conseil*, Vol. XXV, No. 2, pp. 158-167.

Two new implements for fish tagging have been described: "The Tagging Sluice" and "The Hammock Live Container".

The first device is especially advantageous for double tagging of fish, but it may be used also for single tagging, both internally and externally. Since the fish is virtually untouched by hand during the tagging operations, the sluice is recommended for tagging of delicate fish (e. g., herring and mackerel).

The second implement's chief virtue is that it makes it possible to keep fish under sea conditions in a comparatively quiet environment. The structure can be easily dismantled for transport and storage. (Auth. summ.)

3802. Marak, Robert R. 1960. FOOD HABITS OF LARVAL COD, HADDOCK, AND COALFISH IN THE GULF OF MAINE AND GEORGES BANK AREA. *Journal Du Conseil*, Vol. XXV, No. 2, pp. 147-157.

The stomachs of 536 larval haddock, cod, and coalfish were examined. In general, larval fish were eating the most abundant species of food but were restricted to animals of a certain size. Of the many kinds of food available, adults and juveniles of four species of copepods and larval copepods contributed the major portion of the diet. The composition of the food was essentially similar for all years. Fish larvae ranging in size from 4 to 18 mm fed mainly on larval copepods; whereas the bulk of the food of fish larger than 18 mm was adult copepods. Parasitism by *Caligus* sp. apparently did not suppress feeding. (From auth. summ.)

3803. Bishai, H. M. 1960. UPPER LETHAL TEMPERATURES FOR LARVAL SALMONIDS. *Journal Du Conseil*, Vol. XXV, No. 2, pp. 129-133.

The upper lethal temperature for salmon, sea trout, and brown trout alevins reared at 5°-6°C when heated slowly was 23°C. At 24°C, 50% lived for 5 days and at 20°C they could live without ill effects and without any mortality for at least 16 days. Experiments showed that brown trout and sea trout are more resistant to high temperatures than salmon. Acclimation to higher temperatures increases the upper temperature tolerance. The resistance of salmonid alevins with the yolk-sac appeared not to change with age. (Auth. summ.)

3804. Bishai, H. M. 1960. THE EFFECT OF WATER CURRENTS ON THE SURVIVAL AND DISTRIBUTION OF FISH LARVAE. *Journal Du Conseil*, Vol. XXV, No. 2, pp. 134-146.

A review of the effect of currents on the survival and distribution of larval fish is given. An experimental study on the response of fish larvae (*Clupea harengus* L., *Cyclopterus lumpus* L., *Salmo salar*,

Salmo trutta, and *Salmo trutta f. fario*) to current, was carried out. For this purpose an apparatus was designed. Experiments showed that herring and lump-sucker larvae when subjected to current in a glass tube of 12 mm diameter, are not carried passively, but they respond positively to the current, orientate themselves against it, and try to resist it by swimming upstream. For herring larvae a critical current velocity between 0.58 and 1.03 cm/sec. is found at which the larvae can maintain themselves (at least for an hour) against the current. At higher velocities the larvae are drifted with the current but the rate of drifting is less than the current velocity. Salmonid larvae in the yolk-sac stage do not respond to currents. But in later stages when the yolk-sac is nearly absorbed they respond to current, orientate themselves against it and swim upstream. (Auth. summ.)

3805. Miyaguchi, Kiichi. 1959. ON THE SO-CALLED "FRY ZONE" APPEARING IN THE SCALE OF PINK SALMON *ONCORHYNCHUS GORBUSCHA* (WALBAUM). *Bull. of the Hokkaido Regional Fisheries Research Laboratory*, No. 20, pp. 104-108.

Near the focus of pink salmon, circuli are often observed; they are formed in close order. Those zones are called "fry zone" by the fishery scientists of the USSR. Appearance rate of the fry zone is high in the samples collected at Primorskaya province district and low at Kamchatka district. This geographical tendency in pink salmon is also observed in chum salmon. It is thought that the fry zone is formed as a result of physical change of the environment. (Auth. abst.)

3806. Ishida, Teruo, and Kiichi Miyaguchi. 1959. ON THE OFFSHORE DISTRIBUTION AND STOCKS OF PINK SALMON. *Bull. of the Hokkaido Regional Fisheries Research Laboratory*, No. 20, pp. 84-103.

Materials used consisted of fishing records, biological measurement data and samples taken by Japanese mother-ships and land based fisheries as well as those taken by the Japanese, Canadian, and the United States research vessels, in 1955-58.

Distribution pattern and relative abundance of pinks in high seas were compared with those of coastal areas. Comparisons of growth and maturity of high seas pinks were made by area and by season. Some scale characters, namely the number of circuli in first year growth and the stretch of circuli in second year, were analyzed to distinguish stocks. (Auth. abst.)

3807. Stephenson, W., and R. B. Searles. 1960. EXPERIMENTAL STUDIES ON THE ECOLOGY OF INTERTIDAL ENVIRONMENTS AT HERON ISLAND. I. EXCLUSION OF FISH FROM BEACH ROCK. *Australian Journal of Marine and Freshwater Research*, Vol. 11, No. 2, pp. 241-267.

The zonation of dominant organisms on the beach rock at Heron Island was reinvestigated following the work of Endean, Stephenson, and Kenny (1956) and three zoning algae were noticed. Field indications suggested the apparent sparsity of the biota was due

to the browsing activities of fish.

Fish-proof enclosures were constructed, some containing browsing molluscs, and the fauna and flora therein were compared with the surrounding areas by means of detailed general observation, and by estimation of the chlorophyll concentration per unit area of surface. The results confirmed that browsing fish are the most important single controlling factor. (Auth. summ.)

3808. Byars, Jean A. 1960. A FRESHWATER POND IN NEW ZEALAND. *Australian Journal of Marine and Freshwater Research*, Vol. II, No. 2, pp. 222-240.

A year's survey of the fauna and flora present in a freshwater pond provides the first work of its kind recorded in New Zealand.

Attention was given to the effect of the recorded chemical and physical factors on the fluctuations in number of the zooplankton. A comparison of the local phytoplankton and zooplankton with those from similar studies in North America, Europe, and Asia shows the cosmopolitan nature of the inhabitants of freshwater. (Auth. summ.)

3809. Tiemer, Otto W., and James B. Elder. 1960. WILL STUNTED CHANNELS GROW? *Kansas Fish and Game*, Vol. XVIII, No. 1, July, 1960, pp. 3-5.

The growth response of stunted channel catfish transferred from an overcrowded pond to ponds without channels and two with channels was investigated between 1955 and 1959. Stocked fish reached catchable size after one year in new environments irrespective of age when stocked, while fish in the parent population were still below useable size in year class IV and V. Rapid growth of the fish in Dugan's pond when given supplemental feed indicated that shortage of food was the factor that had limited growth. No apparent relationship was found between growth rate of stocked fish and turbidity, size of pond, or presence of other species populations. (Auth. summ.)

3810. Winn, Howard E., and Anthony R. Picciolo. 1960. COMMUNAL SPAWNING OF THE GLASSY DARTER *ETHEOSTOMA VITREUM* (COPE). *Copeia*, No. 3, pp. 186-192.

Etheostoma vitreum, the glassy darter, spawns during three to four weeks in late March to April in water with temperatures that range from 10° to 18°C. The eggs are deposited on a solid surface that is in the path of a strong current. The egg sites are near fine shifting sand areas where this fish lives most of the year. These fish spawn in large communal numbers where aggressiveness is reduced to a minimum. Other details of reproduction are described and discussed.

Biological data seem to relate this fish to the boleosomid darters. It is proposed that the glassy darter with a unique communal spawning habit has evolved from boleosomid-like darters with specialized territorial reproductive habits. (Auth. summ.)

3811. Harms, Clarence E. 1960. SOME PARASITES OF CATFISHES FROM KANSAS. *The Journal of Parasitology*, Vol. 46, No. 6, pp. 695-702.

In 1956 and 1957, 135 catfishes of the species *Ictalurus punctatus*, *I. melas*, and *I. natalis* were collected, representing all months except November, December, and January, from 12 ponds, 2 lakes, 3 rivers, and 5 creeks of northeastern Kansas.

One hundred twenty-four (91.9 percent) of the fish were parasitized by at least one species. Twenty-four species of trematodes, cestodes, acanthocephalans, nematodes, leeches, and copepods were collected.

The degree of parasitism was affected by ecological habitat of host and season of year more than by size of the host. The peak of infection occurred in June, July, and August, during which time 90 to 100 percent of the fish examined were parasitized.

External parasites (leeches, copepods, and monogenetic trematodes) were significantly fewer in ponds than in lakes and streams.

The gut harbored 44.2 percent of all the parasites found; 43 percent were attached to the gills; 1.2 percent were found in the urinary bladder; 0.1 percent were attached to the surface of the skin; and 10.7 percent were encysted in the viscera and mesenteries. (Auth. summ. and concl.)

3812. Blunt, C. E., Jr. 1960. OBSERVATIONS ON THE FOOD HABITS OF LONGLINE CAUGHT BIGEYE AND YELLOWFIN TUNA FROM THE TROPICAL EASTERN PACIFIC 1955-1956. *California Fish and Game*, Vol. 46, No. 1, pp. 69-80.

Stomach contents from 40 bigeye tuna and 18 yellowfin tuna were analyzed quantitatively.

Tuna were captured by longline gear during expedition Eastropic in 1955 and a follow-up cruise in January and February of 1956. Yellowfin were taken in the vicinity of Costa Rica and Clipperton Island. Bigeye were captured near the equator from Ecuador to 500 miles west of the Galapagos Islands.

Bigeye had fed primarily on squid, fish and portunid crabs. Squid are very important in the diet of sub-surface bigeye. Jumbo squid (*Dosidicus gigas*) made up 50 percent of the total food volume.

As bigeye increased in size there was an increase in the mean volume of food items consumed. This appears closely related to the reliance of larger bigeye on large food items such as the jumbo squid.

Large bigeye had more food per pound of body weight in their stomachs than did the smaller fish.

Bigeye taken in the vicinity of the northern edge of the Peru Current had consumed more food per pound of body weight than had those taken west of the Galapagos Islands in the area of the South Equatorial Current.

Bigeye stomach volumes from the eastern Pacific seem to be considerably greater than those from the central Pacific. The presence of jumbo squid in the eastern Pacific and the absence of an equivalent form in the central Pacific may be a factor.

The importance of squid and their deep-living diurnal habits may have an influence on the vertical distribution of large bigeye in the eastern Pacific.

The food of yellowfin tuna consisted of portunid crabs (51 percent by volume), fish (36 percent), and cephalopods (13 percent). (Auth. summ.)

3813. Heiman, Richard F. G., and Daniel J. Miller. 1960. THE MORRO BAY OTTER TRAWL AND PARTY BOAT FISHERIES AUGUST, 1957 TO SEPTEMBER, 1958. California Fish and Game, Vol. 46, No. 1, pp. 35-58.

The otter trawl and party boat fisheries have grown considerably in the last few years. This growth caused concern over possible competition for certain species of fish and resulted in a survey of the two fisheries.

The objectives of this survey were to determine the composition of the catches of both fisheries. In addition, the amount of discard and the sizes of fish taken by the trawlers were to be assessed. These objectives were attained by sampling the trawl catch at sea as well as in the markets, and by sampling the party boats as they returned to port.

The major effort of the trawl fleet was expended in the deeper waters (300 to 750 feet) in the areas adjacent to Morro Bay although market demands resulted in trips for other species to more distant locations. Five trawl vessels were operating from Morro Bay. Twenty-four trips, comprising 64 individual drags, were made aboard these vessels.

The party boat fleet operated inshore from the trawl fleet in depths of 30 to 300 feet. Twenty-six party boats operated in the Morro Bay area. In the course of this survey 890 anglers' catches were examined.

Fifty-two species were taken by the trawlers

while 31 were identified in the party boat catch. These were grouped into five categories: rockfish, flatfish, lingcod, sharks and rays, and miscellaneous fishes. In addition, trawl caught fish were further broken down by desirability into four classes.

By weight the trawl catch were composed of 82.2 percent rockfish, 4.5 percent flatfish, 2.9 percent lingcod, 8.9 percent sharks and rays, and 1.5 percent miscellaneous fishes. An average drag contained 2,106.9 pounds of fish of which 248.5 pounds or 11.8 percent, were discarded.

By numbers the party boat catch was composed of 93.4 percent rockfish, 1.2 percent flatfish, 3.3 percent lingcod, and 2.1 percent miscellaneous fishes. The average catch per angler was 13.9 fish.

The trawl catch was dominated by bocaccio and chilipepper, which made up 80.0 percent of the weight caught. Other species contributing significantly were ratfish, 3.9 percent; dogfish, 3.1 percent; lingcod, 2.9 percent; petrale sole, 2.6 percent; rex sole, 1.1 percent; and longnose skate, 1.0 percent.

The dominant species in the party boat catch were blue and olive rockfish, making up 65.4 percent of the numbers caught. Other important species were yellowtail rockfish, 5.3 percent; vermilion rockfish, 4.6 percent; bocaccio, 3.8 percent; lingcod, 3.3 percent; canary rockfish, 3.0 percent; whitebelly rockfish, 2.9 percent; gopher rockfish, 2.3 percent; and widow rockfish, 2.1 percent.

Because of the separation of areas fished and the differences in species taken, no interfishery competition exists between the two fisheries at Morro Bay. (Auth. summ.)

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